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January 4, 1923

Engineering News-Record

The New Year in Engineering

In this issue:

SURVEYS BY THE EDITORS of the prospects in the various fields of engineering and construction—railways, water supply, highways, municipal engineering, contracting, concrete, traffic, structures, hydro-electric.

THE LABOR SITUATION: Some answers to the questions—Is there a shortage of labor in the construction trades?—What are the facts about immigration?—What is being done about apprentices?

THE MISSISSIPPI FLOOD PROBLEM: Two articles giving the arguments for and against spillways on the lower river, to be followed by the official hydrologic record of the 1922 flood.

FOUR HIGH SPOT ARTICLES on major engineering problems—Engineering phases of city traffic; a resume of the criticisms of the report of the Joint Committee on concrete; developments in hydro-electric practice on the West coast; the future of government irrigation.

CONSTRUCTION COSTS AND VOLUME: The annual review by Engineering News-Record of the amount and value of construction work done in the United States in the calendar year. Contains index numbers.

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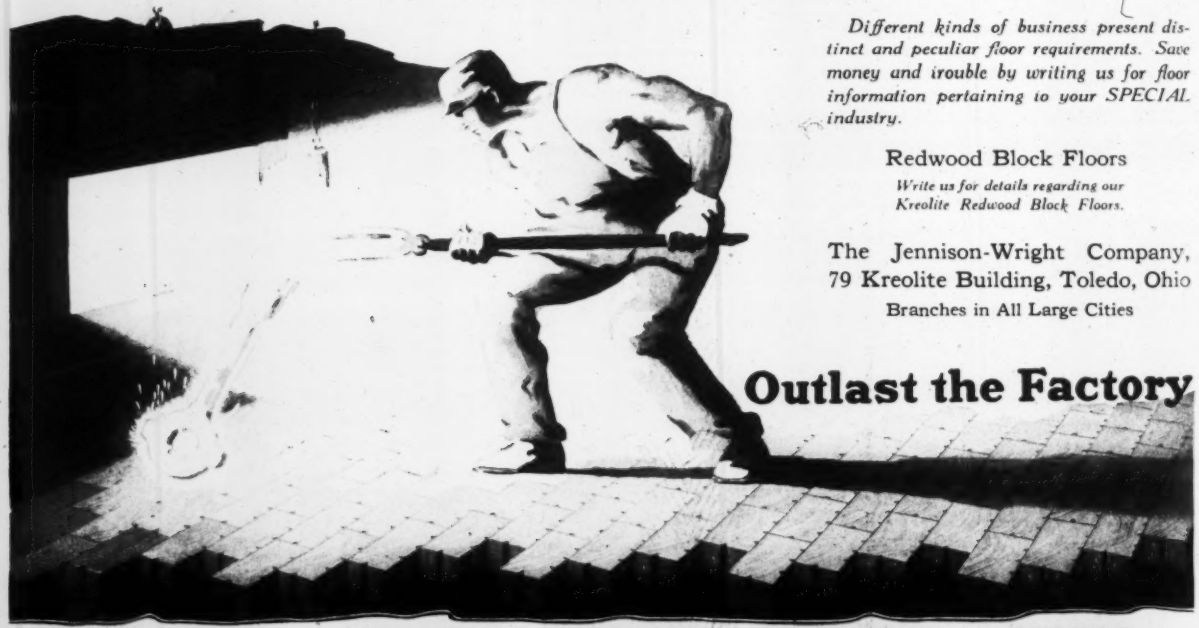

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A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

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Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The Contractor was consolidated with *Engineering News-Record* in 1918.

The staff of *Engineering News-Record* consists of

New York: E. J. Mehren, *Editor;* F. C. Wight, *Managing Editor;* M. N. Baker, F. E. Schmitt, R. K. Tomlin, Jr., C. S. Hill, Willard Chevalier and J. W. Shaver.

Chicago: W. W. DeBerard, E. E. R. Tratman.

San Francisco: N. A. Bowers.

Facing the Future

THE beginning year is the time to light the lamp of experience for better guidance on the way ahead. Each man must do this for himself, according to his needs, his vocation and his experience, but to all in a given vocation there are common sources of light which serve to intensify the light from the individual lamps. This issue of *Engineering News-Record* is intended as such a light for those in the construction industry—for engineers, for contractors and for manufacturers. There are articles on some of the important general phases of the industry, there are the statistical statements of the volume and costs in the year just past, there is a review of the improvements in the machinery and material with which the industry works, and lastly there is a survey, in the columns next succeeding this one, of the state of the industry as seen by the editors of *Engineering News-Record.*

The State of Business

ANY survey of the construction industry must begin with a survey of business in general, for the construction industry is peculiarly the servant of all other industries and under normal conditions responds most quickly and most markedly to fluctuations in the general prosperity. The prevailing sentiment today is one of hope and tempered optimism. Most of the traditional omens are favorable and, excepting for the European situation the clouds that hover in the business skies are not taken to presage any extended or grave disturbance. Car-loadings reached in October a level that barely missed breaking the record; for the current period of the year they never have been exceeded. The banking situation is sound, while the money market is easy in all departments. Retail business is emerging from a holiday trade that has exceeded expectations and that speaks well for the purchasing power of the American people. In the entire situation there is no element of inflation and it is certain that American business will enter the new year with a fair measure of confidence and with indications generally favorable to a continuance of the trade revival.

National prosperity depends largely on the prosperity of the farmer, who today is emerging from the slough of despond. Although there still is an unhappy discrepancy between the prices of what he has to sell and of what he must buy, the margin is closing. But approximately 15 per cent of the agricultural products of the country must be consumed abroad or remain as surplus on the domestic market. Good prices for farm products, then, depend largely on Europe taking its accustomed volume, and although it has been laboring under the disadvantage of low purchasing power, Europe now is beginning to take our surplus in increasing measure. This, it is hoped, may augur an increasing demand not only for our agricultural products but for our manufactured goods as well; for it is only through the demand of a reconstituted Europe that America can attain a generous measure of prosperity.

Conditions Abroad

LOOKING first at fundamental conditions we find western Europe tending toward stability. Fear has given way to confidence; and during the last twelve months production has increased remarkably, both in the industries and in agriculture, in which increased production is reflected not only in increased acreage but also in an increased yield per acre. Coal production in the United Kingdom exceeds pre-war and even in Germany is approaching pre-war volume. In Great Britain unemployment has decreased appreciably during the third quarter of 1922. European industry is coming back, although slowly, and the productive capacity of the European worker is asserting itself in increasing measure.

Turning from these fundamental conditions, however, to the machinery of exchange and national finance, we find the prospect far from encouraging. Three evils are notorious: Currencies are inflated, exchanges fluctuate violently, and national budgets are still woefully unbalanced. Great Britain is making unquestioned progress toward stability, Italy's feet are on the road, but Germany still flounders impotently. France suffers from her reliance upon reparations, which are the evil genius of the situation, for the stability of a European nation may be said to vary inversely with its reliance on reparations as a basis for its national finances. It is obvious

that however much the European may need our goods and however industriously he may labor to attain them, he is under handicap when he must trade in the international market with a depreciated and unstable currency.

The hope of the movement appears to lie in the movement for an economic conference of the nations now taking form in Washington. This idea is being approached from several angles and it is probable that there will emerge an opportunity for this country to participate helpfully.

The Clouds on the Horizon

REFERENCE has been made to certain clouds on the business horizon. One of these is the high cost of government. As has been pointed out in these columns, government is not a productive industry; it is supported out of the earnings of the community for the service and well-being of all, including productive industry. It constitutes an expense which is reflected in the tax burden. In many parts of the country and in many industries this burden is becoming onerous. Much of it, of course, is part of the price we must pay for the war, but in view of this great mandatory expense, there is the more reason why we should eliminate waste, scale down unessential expenditures, and reflect long before assuming new burdens that not only will tax the producing community but also will divert the public wealth into nonproductive channels.

Another cloud is the danger of a nation-wide coal strike in April. Handicapped as we still are from the effects of last year's coal war, American industry is awaiting anxiously the preliminary report of the President's coal commission, due on January 15. The coal operators and miners are now met to consider wage agreements for the coming year. Although the President's commission holds no mandate to mediate between them, there can be little doubt that such findings of fact as the commission may make available between January 15 and April 1 will materially influence public opinion as to the controversy. If happily this public opinion should help to bring about a fortunate outcome of the wage negotiations, the commission will have achieved no small measure of progress in its more far-reaching task.

A third cloud is the danger of ill-considered legislation, of which there is now much talk in Washington. In estimating this danger it is well to remember, however, that unless it be called in special session by the President the new Congress will not convene until next December, and also that the exuberance of a political campaign frequently is sobered by responsibility.

It is rumored that the so-called progressive attack will be leveled against two targets; one, the banking system, and the other, the railroads. Thoroughly legitimate demands for an extension of banking service have arisen out of the distress under which the farmers of the country have suffered during the last few years. The financial problems of the farmer are special and call for special consideration. During the last few years hard times have descended most heavily upon him, with the result that his shrinking purchasing power and his burden of debt have raised a harvest of political discontent. Progress in solving the problem of agricultural credits will be achieved only if it is approached with the idea of actually helping the farmer rather than of punishing some imaginary enemy. Constructive handling of the problem can bring relief to the farmer without prejudice to the soundness of banking practice in general.

The Railroads

THE railroads have had an unhappy year, and some of the proposed legislation now under discussion offers them small encouragement. Their troubles began with the business depression of 1921, as a result of which the roads as a whole earned a net return for that year slightly more than 3 per cent—barely enough to pay their fixed charges. Early last year much thought was devoted to their predicament. It was pointed out that the roads were deteriorating materially because of too-long deferred maintenance, that they were so far behind in the expansion of their facilities that a business revival would find them wanting, that earnings under existing conditions made it impossible to command the requisite capital, and that a failure to remedy these conditions would constitute a grave industrial handicap.

Many hearings were held and remedies were proposed but the net result was a general reduction of freight rates followed closely by wage cuts in the various railroad crafts other than train-service. The shopmen struck, with what results we all know. During their strike the coal strikes were settled, and the American people began to clamor for transportation to move their coal in time to avoid a mid-winter famine. Simultaneously the farmer demanded the movement of his harvest. Despite every handicap, October car-loadings approached closely the record for that month, and with the recent business up-turn there is a possibility of the roads closing the year with a net near 4 per cent.

Progress during the coming year will be subject to the handicap of apprehension as to what the new Congress may do to the Transportation Act. Many business men and farmers are still insistent upon lower transportation charges and legislators are casting about for means whereby to satisfy them. One scheme contemplates a revision of the policy laid down in the act that rates shall be fixed so as to permit a reasonable return on the value of the railroad property; another seeks to scale down the valuations determined by the Interstate Commerce Commission; a third would restore to the several state commissions the authority to fix intra-state rates. Organized labor is dissatisfied with the workings of the Railroad Labor Board and is seeking escape from any regulation that involves compulsory arbitration or an abridgment of the "right of strike."

Danger lurks in these proposals. The Transportation Act has not yet been in operation long enough to prove its merit under normal business conditions. It represents the best judgment of many well-informed minds and is probably the sanest and most progressive regulatory measure that has yet governed our railroad operation. It deserves a better chance than it has had; but if management must function under the shadow of legislative interference, and if the thrifty be frightened away from our railroads into seeking more stable investment for their savings there will be small chance of prosperity for the roads under this, or any other, law.

Despite this general handicap, however, the more prosperous roads, whose earnings are above the average, now have in hand and in prospect a number of projects that will bulk large in the construction activities of the coming year. But assured stability of railroad affairs, coupled with a fair measure of general prosperity, doubtless would increase the number of roads that would dare also to undertake improvements, which, in the aggregate, would mean much to the construction industry.

The Supply of Labor

ANOTHER factor of concern to American industry in general and to the construction industry in particular is the adequacy of our supply of labor, both skilled and unskilled. The exceptional construction activity of the year just passed and the promise of similar conditions for some time to come emphasizes the importance of this factor, and the analysis by Milan V. Ayres elsewhere in this issue deserves thoughtful reading.

Mr. Ayres takes occasion to indicate the possibility of less wasteful use of our present labor supply by a more uniform distribution of construction work throughout the year. The gains to be derived from a smoothing down of the peaks in the construction year were discussed at length in the series of articles on "Lost Time in Construction" recently published in this journal. The need of today is not only for greater production in the aggregate, but also for greater output from present productive capacity; and it is desirable that we consider the possibilities in the latter direction before we take for granted the need for any great additional supply of producers.

This question has a bearing also on the discussion of the immigration problem by Mr. Alexander, who reviews the operation of the 3-per cent immigration law and considers the social, political, and industrial aspects of a national immigration policy. We concur in his emphasis upon the social aspect. Under pressure of current industrial requirements, we are in danger of permitting the industrialist's need for strong backs to transcend the nation's need for worthy citizenship. We need the immigrant's productive capacity, to be sure, but we cannot receive that without at the same time accepting him as an individual, a neighbor, and, perhaps, as a fellow citizen. Any accession of material industrial strength at the expense of our standards of life and citizenship would be a net loss to American welfare, and Mr. Alexander is on sound ground when he urges a counsel based upon national welfare as opposed to industrial expediency.

The Construction Industry

PROBABLY no other single element has contributed so materially to the continued recovery of business in general during the last year as has the construction industry. The effect of greater construction activity cuts two ways; not only does it give direct employment to a broad range of labor, skilled and unskilled, but it stimulates also those basic industries upon which it calls for its raw materials. Much prosperity in many fields has been keyed to the record construction activity of the year just closed.

This is noteworthy because, as has been explained, construction normally is the servant of other industries, dependent upon their general prosperity for its own impetus. When commerce and industry prosper, the construction industry is called upon to expand existing facilities and to provide new; but when depression looms, industry seeks to keep its resources liquid and to cut to a minimum the volume of capital tied up in plants or otherwise fixed. As construction is essentially a process of fixing capital, it languishes. During the last year or two, despite the general business depression, the industry has thrived because of special influences that have been brought to bear upon it.

One of these is the shortage of commercial and home building during the war. This deficiency is not yet made up and there will be need for more than normal activity for some years to come. Declining costs during the early months of last year were responsible for the contribution of 1922 toward making up the deficiency. Another factor has been the federal and state-aid highway construction program. The federal-aid program, authorized in 1916 and put under way in 1919, attained its stride only during the year just past, with consequent increase in construction activity. A third influence making for increased construction has been the tax-exempt securities issued by governmental units. This has brought about during 1921 and 1922 the largest volume of state and municipal bonds of which there is record, amounting to more than two billion dollars.

Contracts let during 1922 are estimated at about four billion and a half of dollars, or about one-third more than during 1921. Although much of this work has been completed, some of it has not yet been started. The indications are that 1923 will equal or surpass the record of 1922. *Engineering News-Record* Volume Index, which takes into account variation in purchasing power of the dollar and therefore reflects more accurately the actual volume of construction work, increased from 88 in 1921 to 130 for 1922, the last month being estimated. These are based upon a value of 100 for 1913. Important awards covering public works and fireproof buildings reported by *Engineering News-Record* during 1922, excluding industrial contracts, were worth $1,411,000,000, as against $1,117,000,000 for 1921. Large industrial contracts also showed an increase from $114,000,000 in 1921 to $164,000,000 in 1922. The building permits issued in 166 cities, according to the Federal Reserve Bank statistics, were for the first nine months of 1921 $1,196,000,000, while for the first nine months of 1922 they amounted to $1,879,000,000.

Since March, costs have been rising and are now about 15 per cent higher than they were a year ago. On the other hand, the average cost of construction of all kinds in 1922 was, according to *Engineering News-Record* Index 14 per cent under the average cost in 1921. During 1922 the cost index varied from 168.72 in January to 192.60 in December. Of the prime materials, steel, as compared with pre-war prices, is cheaper than lumber, cement, and brick.

Taken altogether the year-end developments point to a continuation of building activity, subject always to the danger of restriction that might be brought about by runaway prices for labor and material.

Municipal Engineering

A MORE favorable bond market and some reduction in costs stimulated construction in the municipal field in the early and middle parts of 1922. A reverse in both respects later on acted as a brake and if continued may retard progress in making up for deferred construction. Besides the stimuli already mentioned, water-works construction was facilitated in some cities by readjustments of water rates, including some municipally-owned plants. Strong arguments for improvement in the financing of municipally-owned works, going as far as the advocacy of putting such works under the control of state utility commissions, were advanced during the fall and early winter at meetings of the New England Water Works Association.

Throughout all branches of the municipal service, mounting debts, interest charges and tax rates present a serious problem, but one too little recognized and when recognized too seldom squarely faced by municipal authorities.

In water filtration a tendency to go above the standard rate of 125 m.g.d. for mechanical filters is apparent. The very high rate of 175 m.g.d. adopted for the Detroit filters—the largest in the world—may be considered as exceptional, and due in part to local conditions that favor a higher rate. Buffalo, St. Paul, Omaha and other cities are providing for filtration. Some of the new plants will treat waters that only a few years ago would have been considered quite satisfactory without treatment and which, even now, have little against them so far as danger of producing disease is concerned; but in all these cases there is a degree of added safety that warrants considerable expense and a gain in physical qualities that is well worth while.

The activated-sludge process is still the center of interest in the sewage-works field. Construction of the Milwaukee and Indianapolis plants is now well advanced, and several plants are in use or projected by the Chicago Sanitary District. In Canada and in England the process seems to be gaining in favor. Dewatering the sludge from the activated-sludge process continues to be the subject of study but it is significant to note that after the most varied and extended tests of sludge treatment ever made at one place, Milwaukee has adopted heat-acid conditioning and the Oliver vacuum filter, with drying by heat as the final stage. Whether a marketable sludge can be produced by the activated-sludge process has not been proven. Much of the uncertainty lies in the variability of the demand and price for fertilizer base—which also works against garbage reduction.

Garbage disposal is still shifty as to methods in favor—largely because it is the football of party changes in political administration of cities and not yet generally recognized as an engineering service. Although instances of incinerator shutdowns after a few months or years of operation are numerous, there seems to be a decided tendency of late to install incinerators; particularly several in a city, so distributed as to reduce haulage costs. The British type of high-temperature destructor, with attempts at heat utilization, is losing ground. Even in England it is being displaced by disintegration and screening (of mixed refuse), with more or less use of clinker for concrete and of fine ash and shredded garbage for land improvement. Garbage reduction and hog feeding have both had a setback owing to the poor market for grease, fertilizer base and hogs. All these conditions tend to garbage disposal in conjunction with ashes to fill low land, at least as a temporary measure in medium-sized and small cities.

City planning is slowly but surely becoming established as an essential to municipal progress and economy. Most of the planning and re-planning work that has got to the construction stage is street widening and extensions, to provide more adequate arteries for the rapidly growing use of automobiles and motor trucks. Traffic regulation and the control of parking are being pressed to the front—not always with due recognition of the fact that the fundamental need is more adequate travel routes. City zoning is making more substantial progress than other branches of city planning—partly because it costs less in time and money than does street planning and construction and largely because it is now being recognized as the basis of many other lines of city planning.

The great needs of the future in the municipal field are co-ordinated planning, both physical and financial, with a far look ahead, and emancipation from partisan politics and the resulting inefficiency.

Road Construction Stabilized

HIGHWAY construction was slightly less active last year than in 1921. As a matter of comparative record this fact is of interest. The conclusion of importance, however, is that, with the advance of the last twelve months, the country is committed to a long program of national and state highway extension which only unusual circumstances can interrupt. It does not signify much, therefore, how the volume of work performed swings up or down a little in any year. The essential facts are that there was a large expenditure for road improvement in 1922 and unless all indications are unreliable there will be substantially as great an expenditure in 1923.

Being committed to a long program of highway improvement does not indicate that the public is passive in its attitude toward the volume and the management of its highway appropriations. An outstanding feature of the year's activities has been a disposition to review and criticize expenditures for road construction. This is, fundamentally, the result of present general economic conditions reflected as an inclination to curtail heavy spending. There is no indication that public sentiment does not generally favor improved roads. There is indication that it resents paying uncurbed prices for improved roads. With improved business conditions and better prices for farm products, conditions are possible which may entirely change the inclination toward frugality which now prevails. A helpful influence will be education of the public by road officials in highway technic and economics.

Technically road building has made decisive advances. Research work completed during the year gives highway engineers means to approach the rational design of pavements. Methods of construction have been better formulated, and, more significant than this, four years of intensive road building has developed a corps of skilled road contractors. Maintenance has been widely extended. There are many facts indicative of all these conclusions and they will be reviewed in the coming issue of Jan. 11 devoted especially to highway engineering in honor of the convention and exhibition of the American Road Builders Association.

Research, design, construction and maintenance all showed progress in 1922. Administration made little progress. It is true that there were increased forces and better organization in detail, but in the broad essentials of freedom from political interference, salaries adequate to responsibility and centralized authority there was little forward movement. Such advance as is indicated is due largely to the requirements which Congress laid down under the advice of the Bureau of Public Roads in its latest federal-aid legislation. A public and official awakening to higher principles and greater proficiency in highway administration is one of the requirements which the last twelve months record has impressed on forward-looking highway officials.

Water Power Normal

IN THE current review of hydro-electric progress on another page practically all attention is given to Western developments because there, it seems, the most progress is being made in hydraulic power generation. The East has not been idle during the past year but its development has been more on the even curve upward of past achievement. It is not forgotten that Niagara is the premier water power in the world and that records for size of units, for totals generated, for canal capacities and for tunnel sections are still held there but outside of Niagara there is no new hydro-electric project east of the Rockies which its designers would claim to be more than the normally improved practice. The novel semi-enclosed power house at the Mitchell Dam of the Alabama Power Co. and the low-head, high-speed propeller wheels at Winnipeg and at the Ford plant at Troy are steps forward noted last year.

But if the East does not show any great novelty in practice, it is apparently on the eve of a greatly increased development of water power. During the year past several extensive investigations of large watersheds have come to light and several others are still matters of private concern but all are apparently merely waiting for favorable financial conditions to be transformed into actual construction. Such companies as the Southern Power and New England Power continue steadily to extend their operations farther and farther back toward the headwaters of the streams descending the Appalachian range and others such as the Clarion River in Pennsylvania and the Tippecanoe in Indiana to open up new sources. The distinguishing features of such projects is the extent of the vision of their projectors. No longer in the East is the development of one falls or even a short stretch of river attacked as a single problem. Rather is the area to be served considered as a whole with farseeing plans for the tying in, by reservoirs as well as by electric lines, the outlying units so that eventually all of the rain falling on a given slope will be made to do its maximum work. This is a desirable end toward which, as our fuel supply diminishes, all power development must tend.

In details of hydro-electric design there have been no outstanding features. The major manufacturers are working all the time toward an increase in efficiency and decrease of complication and at no one time is it possible to point to a definite marked step ahead. The possibilities of the propeller and the combined impulse-reaction wheel have been remarked before; the remodeling of draft tubes for greater ease of egress seems not to have progressed beyond the novelties of a few years ago. The automatic station for the smaller capacities is growing more and more practical. Outside of these, design details are not remarkable for novelty.

The Federal Power Commission continues to operate under difficulties because of lack of personnel. With this limitation it has managed to do a prodigious amount of preliminary work both in examination of projects and in establishing proper accounting rules. Actual progress under the federal law continues to be disappointingly small. Applications have been made in great numbers but only a few (outside of the big Niagara development) have been transmuted into horsepower. By terms of the law these pending applications must soon either lapse or become active so that the real test of the law will come when the lives of the applications begin to reach their end.

Irrigation's Future

IRRIGATION possibilities in the West are still great. In the public domain alone, according to F. H. Newell, consulting engineer, United States Reclamation Service, some 20,000,000 acres might be reclaimed, or more than ten times the area for which water has been provided by the Federal Government. It has taken twenty years, including the time spent in preliminary studies, and has cost about $135,000,000 to irrigate some 2,000,000 acres. Allowing a 50 per cent increase in construction cost, to water the remainder of the irrigable public domain would cost $2,000,000,000. If it be assumed that the reclamation fund—derived from sales of public land, royalties on the production of oil, etc., and repayments to the fund by settlers on account of construction costs—would amount to $10,000,000 a year, it would be 200 years before all the irrigable public domain was supplied with water for irrigation. Recent financial and industrial conditions have slackened the contributions to the Reclamation Service fund, so that without radical changes in financing there is no prospect of $10,000,000 a year becoming available for many years to come. Already $20,000,000 of bonds have been provided to expedite the completion of projects under way. As these bonds are payable at the rate of $1,000,000 a year from the normal reclamation fund they reduce by that sum the current construction fund. Further depletion arises from a congressional relief act approved March 31, 1922, authorizing the extension of the time for paying construction charges against settlers. Besides credit for the first cost of irrigation projects some of our best authorities—Elwood Mead, for instance—urge that loans should be made to help the settler prepare the land for cultivation, put up buildings, buy tools and live stock. This would greatly increase the total of public funds advanced to finance irrigation projects.

It is taken for granted that the federal government will continue to build or at least to finance or help finance the larger of the irrigation projects of the country. The Reclamation Service was created because of the conviction that the irrigation works awaiting construction were too large and the economic and human problems involved too many and complex for private enterprise, as they were also beyond the financial capacity of irrigation districts and even of entire states. The irrigation works of the future will require still more capital and skill. Add, for instance, the cost of the huge Columbia River Basin Project to the minor projects that would press for simultaneous execution, and then increase all this by the settler's loans for lands, buildings, tools and livestock, already mentioned, and the total becomes so large as to make it patent that the future of irrigation in the United States is a subject demanding searching study by engineers, agriculturists, economists and statesmen.

Federal Engineering Queries

THIS question of federal expenditure for local benefits is just now of tremendous importance to engineers. Leaving aside the long established river and harbor policy and the more recent federal aid to highways, there are five outstanding engineering projects now before the American people the cost of which will run into the billions and the benefits from which are primarily local, though each has an ultimate relation to national welfare. These are the St. Lawrence improve-

ment in the northeast, Muscle Shoals in the southeast, the Columbia Basin irrigation in the northwest, the Colorado River in the southwest, and the Mississippi River in the central section. If each is examined it will be seen that the arguments in their behalf are identical. The advocates of each claim that through its construction there will flow out over the country a general reduction in the cost of living and a corresponding increase in the amenities of life; the St. Lawrence project will create cheap power and lower grain prices, the Colorado control, the new Columbia basin, and the Mississippi flood retention will decrease farm produce costs. Muscle Shoals will give cheap fertilizer.

Yet in each case the immediate benefit is obviously to those in the range of the improved districts, and the main reason they themselves do not undertake the work is the enormous cost which, partly from selfish reasons and partly from absolute inability to shoulder, they would pass onto the general government. On the theory which governs road aid and river and harbor work, each section should agree to all of the projects if its own is authorized, but in these five huge schemes the grand total of cost is staggering and quite beyond the power of the government to assume. We come, therefore, to an impasse which promises to delay each of the admittedly desirable developments until some way other than national control is found. In the case of the St. Lawrence and Muscle Shoals, private ownership is offered, but so far, at least, that easy way out has not appealed to the people. On the Colorado seven states seem in a fair way toward assuming the disproportionate proportion of cost their disproportionate benefits suggest. The Mississippi, it would appear, must remain mainly a national expense to be paid out in small amounts year by year until complete.

Mississippi Problem

AFTER every big flood on the Mississippi there arises a clamorous demand for a new method of protecting the valley against the rising waters. Most of the clamor is from people ignorant of the history of the river or of the science of river control who are either personally affected by the floods or are impressed, from a distance, by the stories of the almost irresistible power of the mighty river. Such criticism is negligible; it has neither authority or permanence, and it generally puts its faith in such discredited relief means as reservoirs, forest planting and contour plowing. There is, however, after each flood a large body of expert critics which, with more or less justification, offers methods of control in opposition or in addition to those now accepted in the continuing plan of the Mississippi River Commission, the supreme power over the river from Cairo to the Passes.

The record flood of 1922 proved no exception to the rule. In spite of the fact that there was less actual damage by this highest of floods than from any of those approaching it the past four decades, the daily and long continued menace of the weakened levees and the almost superhuman efforts required to prevent a dozen prospective breaks along the river—to say nothing of the three crevasses that did occur—combined to warn experts and laymen alike of the possibilities that may follow a quite conceivable discharge greater even than this greatest yet recorded. Out of all the post-flood study and agitation, however, there arises only one suggested protective measure which has any degree of plausibility or of unanimity among those qualified to discuss it. This is the spillway at some or several locations below the mouth of the Red River. There are some faint whisperings of criticism of machine built levees, some suggestions for improvement for revetment designs and a competent demand for study of river hydraulics through a model river in a laboratory, but these are generalities which do not promise an immediate program.

The review in this issue states adequately, we think, the pros and cons of the spillway argument. It may be pointed out that each side avoids extensive reference to the main criticism of the other. The spillway advocates are little concerned with the structural stability of a spillway or weir; Colonel Townsend dismisses rather lightly the long held contention that the main arguments against a spillway is the possible silting up the river below the spillway. Of the two omissions, Colonel Townsend has the better of it in that he is arguing about something that is tangible and assured, the tremendous force of 250,000 sec.-ft. of water and the difficulty of building on the Louisiana alluvium any dam or weir that could withstand it. That is an engineering problem of gigantic proportions and while it is by no means inherently insoluble its solution involves courage and huge expenditure. The danger from silting, on the other hand, lies in the realm of river hydraulics, which is still far from an exact science and where experience is a more powerful teacher than theory. Only observations after the fact will be conclusive as to the effect of a spillway on river depths.

Meanwhile the Mississippi remains a serious problem, for even the spillway advocates admit that the levees must be continued, spillways or no spillways. All they claim for the spillway is that it will take off the crest of the flood and thus preclude the necessity of raising levees which are already at or near their maximum safe height. No scheme has yet been proposed, or at least seriously considered, which will relieve the country of the obligation of lining both banks of the Mississippi from far above Cairo to well below New Orleans with high stable mounds capable of withstanding, without anxiety, any ordinary high water and safe as human things can be against the highest water possible. There always remains the chance that distributed rainfalls will combine to cause higher water than ever before and that the established levee heights will be overtopped.

Structural Activity

THERE has been a brisk and growing activity during the year in the businesses depending on structural engineering, but technical growth has not been marked, and research has produced few results. By far the encouraging feature of the year's progress is a rebirth of interest in research, evident in all parts of the field of civil engineering, which promises much for the future. Quite independent of this an outstanding development impresses itself on the careful observer, namely a movement toward economy of material by the reduction of excessive safety factors.

Efforts toward commercial and industrial uniformity, represented chiefly in the work of the federal Department of Commerce and the American Engineering Standards Committee, have continued, unobtrusively. Their most important result is a model building code for small houses and a draft of simplified house plumb-

ing rules. Fire-protection matters received attention in a new direction after the Burlington railway office building in Chicago was swept by fire, early in the year, bringing to the front the exposure fire problem and the dangers centered in downtown districts. Even aside from this, there has been fully the usual amount of advance in the long struggle against the fire waste, and building law development has been effective.

A situation of decided interest has come about in the field of bridge construction, due to a demand for highway crossings over wide bodies of water where ferries now serving transportation are finding it difficult to meet the needs of increased traffic. All the large highway bridges projected are being brought forward as private undertakings; the Philadelphia-Camden bridge, already under construction, is the only large public bridge enterprise. Opinions differ as to public policy on the question of toll bridges or free public bridges for such cases, where the work is necessarily of large cost. It is unmistakably evident, however, that in spite of its large expenditures for free improved roads the public is not very willing to supply funds for costly long-span bridges; many men, indeed, hold the view that their cost should be assessed on the user by adopting the toll-bridge plan of construction.

Structural materials, finally, brought forth no important innovations during the year—or for that matter during several years. An advance was confidently looked for a few years ago, the extension of the use of alloy steels, has lagged decidedly. Prices do not encourage rapid progress in this direction. That the weight factor maintains its influence on bridge practice, however, is expressed in the fact that an exceptional number of suspension structures figured in the year's developments, including the short-span highway bridge at Kingston put into service last summer, and that all the long-span projects involve wire cables, with the single exception of a recently ordered structure with suspension chains of treated, high-strength eyebars.

Progress in Concrete

PORTLAND cement production in 1922 will probably prove to be around 115,000,000 bbl., by far the record year in the history of the material. This means that more concrete was placed in 1922 than in any other year, but just where it is going statistics do not show. Concrete road construction was little, if any, greater than in the preceding year nor do such figures as are available indicate that industrial buildings of concrete were noticeably more than in recent years. There remains, then, general construction, which was heavy, and the multitude of small uses of concrete by builder and farmer which in all probability accounts for most of the increase.

At any rate, more concrete was used than ever before, which is interesting particularly in view of the fact that less obvious forward progress was made in the study of concrete design and construction than for some years. The report of the Joint Committee was before the engineering public the whole year and was discussed at a series of meetings and by the committee but its final revision will not be made until some time this year and it would be unsafe to predict what form it will take except to say that the strength design clause will probably be killed or emasculated. The main result of the long discussion has been to show that the contractors are too prone to stand on the principle that whatever is is right and forward-looking engineers too willing to take prospects for actualities.

Research in concrete continues to spread and, as the vast amount of work already done appears on the record, more and better co-ordination of effort is to be expected. During the past year, however, there were no outstanding investigations to report. The value of research and education is beginning to show in concrete construction, the standards of which have risen measurably in the past few years. It is no longer true that only a few contractors are competent to build in concrete, or that a great majority are careless of the fundamentals of safe construction.

In cement itself, there is evident a newborn interest on the part of the manufacturers in the make-up of their product. They are beginning to look beyond the detail chemistry of manufacture into the chemistry of behavior and to step beyond a too rigidly held attitude that portland cement is a perfected product. A continuance of this policy promises much toward insuring a more permanent concrete.

Equipment and Materials

DEVELOPMENTS during 1922 in the construction equipment and material fields were characterized by widespread improvement in details of well established types of machinery rather than by the introduction of new types. Efforts have been directed to strengthening parts, increasing sizes and capacities, simplifying operating control, and, particularly, to increasing the mobility of portable equipment. This trend is clearly seen in the increasing use of rubber tires, both solid and pneumatic, for machines which were formerly moved upon steel rims. In a number of cases, too, motor-truck chassis for concrete mixers and elevating loaders have been adopted. In the mounting of equipment, too, the year has developed an extensive use of crawler traction, which has been applied not only to locomotive cranes, concrete mixers, elevating loaders, and the light revolving types of steam shovels, but also to the heavy-duty railroad shovel.

One of the notable steps taken during the year was the equipment of power shovels with Diesel engines. The use of gasoline engines for operating construction equipment showed a decided gain during the year and the multiple-cylinder types are being employed more widely than ever before. Great strides have been made in the application of pneumatic hand tools to construction work. In the field of industrial locomotives and elevating loaders transmission has been introduced to give a greater variety of speeds than formerly and the large types of paving mixers have now reached the stage of self-contained units, fully equipped not merely for mixing and delivering concrete but for handling aggregate delivered in batch-boxes. Concrete chuting has, until recently, been considered economical only for large-scale work, but manufacturers have evolved simple and cheap equipment of this type for small jobs. In the rock crusher field the introduction of cast-steel frames instead of grey iron, is a move to increase durability.

Among developments also should be noted devices for measuring and handling concrete aggregate and the perfection of mechanical loaders of the elevating bucket type. The year also witnessed the manufacture, in the United States, of both concrete and cast-iron pipe by the centrifugal process.

The Labor Shortage—Its Volume and Means of Relief

Labor Shortage in the Building Trades—Immigration as Affecting the Labor Situation—Apprenticeship and Seasonable Employment

As a contribution to the study of the serious shortage of labor in the building trades there is started in this issue a series of articles which should help to a better understanding of the situation. They include, first, a statistical study of the actual labor shortage, statistics which have hitherto not been available, an analysis of the immigration situation by the head of the National Industrial Conference Board which has been engaged in a survey of this subject, a discussion of the apprenticeship system, its defects and some attempted remedies, and finally, the story of seasonal employment in Philadelphia, where a special investigation of that situation has been made. The first two of these articles appear in this issue. The others will follow in succeeding issues.

How Great Is the Shortage of Building Trades Workers?

By Milan V. Ayres
Statistician, Associated General Contractors of America

HOW serious is the shortage of building trades workers? A brief and correct answer to that question would be, "Nobody knows." We do know, however, certain facts which are clearly related to the problem, and which would have to be taken into account in formulating a complete answer if such an answer were possible.

Table I shows the number of people employed in certain trades in this country as recorded in the census of 1910 and that of 1920. Some of the groups enumerated in the table are clearly people engaged in the construction of buildings, while others, such as electricians, plumbers and carpenters, include a considerable number of people working in shops or in other occupations not identified with new buildings. Table II shows, by the length of the bars, what percentage the people in each group in 1920 are of those in 1910. The first four classes, electricians, structural iron workers, plumbers and carpenters, have increased in numbers during the decade, while all of the others have decreased. During the same period the population of the country increased 15 per cent, so that only the first three groups increased as fast as the population.

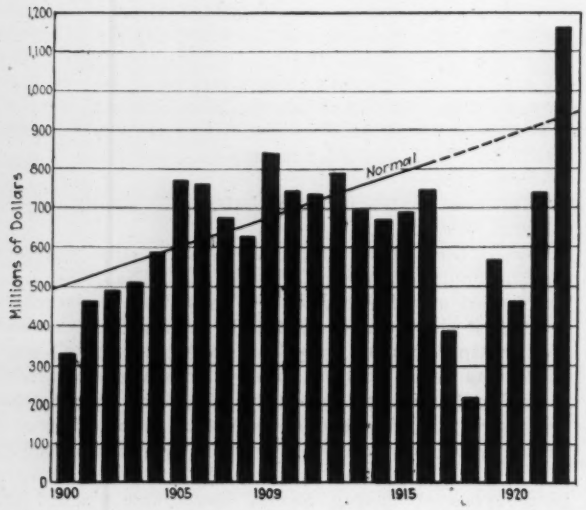

FIG. 1—VALUE OF BUILDING PERMITS FROM 1900 TO 1922

Value of building permits for 50 cities each year from 1900 through 1922 after data have been converted to 1913 cost basis. Straight line shows general trend from 1900 through 1916.

These figures seem to indicate that there must be a most alarming shortage in most of the building trades, but there are a number of reasons for believing that conditions are not nearly so bad as the census data seem to imply. Because of their authoritative character, it is almost necessary to begin any discussion of this subject with a consideration of these census figures, but I shall show further on that they really mean comparatively little.

The heights of the columns in Fig. 1 show, according to the best available information, the relative amount of building in our American cities each year, beginning with 1900 and ending with 1922, the figures for the latter year being, of course, partially estimated. The heights of these columns are proportional, not to the amount of money spent on building each year, but to the actual physical volume of work done. The figures from which the diagram is plotted were obtained by finding first, for each year, the total cost of all the buildings for which permits were issued in a list of 50 cities, and then dividing the figures for each year by the index number of the cost of building.

This process gives figures which show how much the buildings for which permits were issued in each year would have cost if the cost of building in that year had been what it was in 1913. The heights of the columns are proportional to these latter figures, and are therefore also proportional to the actual volume of the work done.

It is, of course, true that building sometimes costs more and sometimes less than the figures set forth in the permit, but the errors introduced by this fact are largely compensatory and whatever error finally remains is almost certainly about the same percentage of the total for each year, so that the results probably show with ample accuracy for our purposes the relative volume of building year by year.

The year 1909 was clearly the biggest building year in our history prior to 1922, and the 1910 census was taken in the year following, which was also a very good building year. On the other hand, the 1920 census was taken just following a period of several years during which building was sub-normal, and before the present building recovery had achieved any considerable headway. A natural result of this state of affairs was that men who had formerly been employed in building operations had been forced to find other work, and most of these, naturally, were reported by the census as engaged in these other occupations which they had taken up.

TABLE I—WORKERS IN CERTAIN TRADES, 1910 AND 1920, AS REPORTED BY CENSUS BUREAU

Trade	1910	1920
Electricians	120,241	212,964
Structural iron workers (building)	11,427	18,836
Plumbers and steam and gas fitters	148,304	206,718
Carpenters	817,120	887,379
Painters, glaziers and varnishers (building)	273,441	248,497
Brick and stone masons	161,781	131,264
Roofers and slaters	14,078	11,378
Plasterers	47,682	38,255
Paper hangers	25,577	18,746
Laborers, building, general and not specified	869,478	623,203
Laborers, road and street building and repairing	180,468	115,836
Stone cutters	35,731	22,099
Total	2,705,328	2,535,175

It is also an important fact in this connection that the 1910 census was taken in midsummer when building operations were active, while the 1920 census was taken in January when building is always at the minimum, and many men whose normal occupations was on construction work doubtless were doing, temporarily, something else. Many of these, undoubtedly, were enumerated as belonging to the occupation in which they were engaged at the time rather than to the trade in which they really belonged. The obvious conclusion is that the census figures reflect the relative activity of building in the two periods when they were taken much more accurately than they do the number of workers qualified to work in the building trades.

The sloping line marked "Normal" in Fig. 1, represents the trend in building operations in the 50 cities from the year 1900 to the year 1916. If each of the columns covering this period reached up to this normal line and stopped there, the sum of the heights of all the columns would be the same as it actually is, and the increment in height of each column over the preceding one would represent the normal annual increase in building. This line is obtained by a mathematical process based on the theory of least squares, and may be described as the best line which can be drawn to represent the trend in building operations over this period. The portion of the line to the right of 1916 is simply an extension of the other part and is drawn on the assumption that if the war had not occurred, building would have continued to fluctuate about this line in much the same way as it did before. Perhaps the most noteworthy fact revealed by this line is that the year just passed is the first one since 1912 when building operations have been up to normal.

The figures on which this chart is principally based were first computed by Col. Leonard P. Ayres, Vice President of the Cleveland Trust Co., and published in a monograph entitled "The Prospects For Building Construction in American Cities." In that work he shows that building construction in these 50 cities was on the average at the end of 1921 two and one-half years in arrears.

According to my computation, building in these same cities for 1922, represented by the last column in Fig. 1, was 26 per cent above normal. This means that if building should continue as much above normal as it has been this year, for the next ten years, the accumulated shortage of the war period would just about be made up. To accomplish this would mean not merely as much building as this year, but an amount next year greater than this, and the year after that still greater, as indicated by the slope of the normal line. The amount of this annual increment represents a volume of building which, at the present prices, would cost for the 50 cities in question, about 36 million dollars.

Unquestionably there has been some shortage in building trade labor this year. I think nobody could look at the height of the last five columns in Fig. 1 without realizing that there would have to be some shortage. If there were enough men in the country competent to do building work, it is clear that many of them must have been from necessity engaged in some other kinds of activity three years ago, and of course these men could not, all at once, be transferred from their other occupations into the building industry. It does, however, seem altogether probable that there are not enough men available for these trades to carry on building work at the intensity corresponding to the greatly increased volume of permits issued and contracts let during 1922. Undoubtedly many of the men who have

TABLE II—BUILDING TRADES WORKERS, 1920 AND 1910

Workers in certain trades in 1910 in per cent of the numbers in the same trades in 1920, as reported by the Census Bureau. If the number of people in any trade had remained constant the bar would reach to the 100 per cent line. If the workers had increased in proportion to the population the bar would reach to the 115 per cent line.

taken up new vocations during the prolonged period of sub-normal building will refuse to return to their old trades. Also it is clear that conditions of the past several years must have prevented many men from learning the building trades, who in normal times would have done so. Another fact of importance in this connection is that since the outbreak of the war in 1914 inmigration has been at a very low ebb, so low that in some of those years more workers have left the country than have come in.

One of the important facts affecting the supply of building labor is that the industry is seasonal. More men are employed at it in summer than in winter. If a uniform number could be employed throughout the year considerably fewer men would be required. When we come to analyze this situation, however, and inquire how many more men are employed at the height of the season than on the average, we find the available information very meager and unsatisfactory. The heavy, solid, irregular line in Fig. 2 shows the way in which building permits vary in our American cities during

an average year. The figures from which the line is plotted are taken from monthly averages of permits issued in 177 cities during 11 years. They show that 5.8 per cent of the total value of the year's permits are issued in January, 6.1 in February, and so on, reaching a maximum of 10.3 in April, and ending with 7 per cent in December.

It is quite customary to speak of building activity as

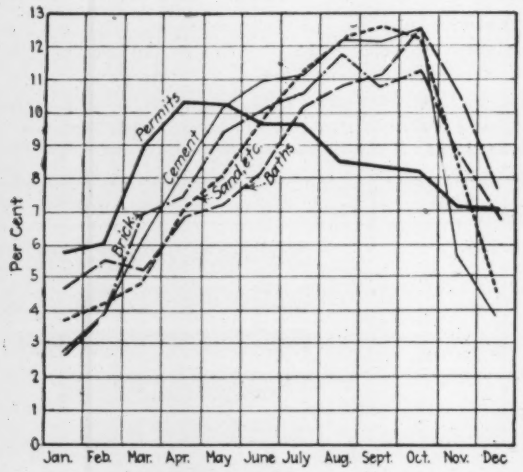

FIG. 2—ANNUAL CYCLES OF BUILDING PERMITS AND MATERIALS PRODUCTION

Annual cycle of building activity, as shown by the per cent of the yearly total included in each month for building permits issued, face brick shipped from yards, cement shipped from mills, sand, stone and gravel loaded on cars and bath tubs shipped from factories.

increasing during the time when these monthly permit figures are going up and as decreasing when these figures are going down. This, however, is obviously wrong because the building activity in fact comes after the issuance of the permits, and it is perfectly certain that the month when the greatest number of men are employed in building is much later in the year than the month when the greatest value of permits is issued. The other four irregular lines in Fig. 2 represent the relative monthly volume of shipments of four kinds of commodities used in building; namely, shipments of cement from the mills, shipments of sand, stone and gravel by rail, shipments of face brick from the yards, and of bathtubs from the factories.

Unfortunately all four of these sets of figures are for one year only, that of 1921; this being the only full year for which they are available. If averages over a longer period were to be had, doubtless these lines would present fewer irregularities. As it is they represent a remarkable degree of likeness; all of them culminate in August, September or October, and none of them is any where near a maximum in April when permits reach their highest figure.

Obviously these materials cannot be incorporated in buildings until after they arrive, so that these figures point to a culmination in actual building activity even later than the time at which shipments reach their peak.

The heights of the columns in Fig. 3 represent the relative building activity of each month of the year on the assumption that that activity is correctly determined by averaging the percentage distributions throughout the year of the four classes of building material shipments shown in Fig. 2. If these assumptions are correct only 3.4 per cent of the year's building is done in January while the peak is reached in October, with 12.2 per cent, and the year ends with 5.7 per cent in December. On this basis about 3.6 times as many men are employed in building in October as in January, and there have to be about 47 per cent more men engaged in building in order to meet this October peak than there would have to be if building could be conducted uniformly throughout the year.

I am discussing this seasonal effect in building at some length because it is altogether probable that we are by no means through with the effects of labor shortage in the industry, and one of the ways by which that condition can be alleviated will be by spreading the work more uniformly over the year. In fact, I do not hesitate to say that if this could be completely accomplished, there would be no shortage at all of skilled labor in the building trades. I am not so sure, however, that this observation applies to common labor.

I have said that building could go on at a rate even greater than that of this record year for a period of ten years before completely catching up with the present building shortage. This, however, is not going to happen. Neither building nor any other kind of industry ever continues as smoothly as that would imply over so long a term of years. There are sure to be periods of business depression and of prosperity during the coming decade which will have their effect upon the building industry. It would be folly to attempt a prognostication of the time or extent of these fluctuations. It will be sufficient, perhaps more than sufficient, to venture on a prediction for the coming year. There are no indications that the present building boom has reached its end. On the contrary, recent figures show less than the usual seasonal reduction and indicate that, considering the time of year, the building boom shows greater strength now than in mid-summer.

I believe 1923 will be a year of great building activity. I do not believe, however, in spite of recent figures that it will witness a total of as much new building undertaken as has 1922. I have several reasons for this conclusion. One is that I think the edge has been taken off the demand, that is, the most urgently necessary building has already been started. Another is that money rates are going up and, I believe, will continue to rise practically throughout the coming year, and a rise in money rates always has a deterrent effect on building. Another reason, or another phase of what is really the same reason, is that general business prosperity is increasing, and experience has shown that during times of increasing prosperity, we stop spending money for speculative building enterprises and put it instead into industrial expansion, where it seems to hold out prospects of a greater return. I think, then, that while 1923 will probably not witness quite so much building as 1922, it will, nevertheless, be a very active building year, and will develop a demand for building trade workers only slightly below the demand experienced during the past year.

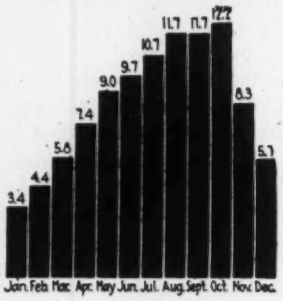

FIG. 3—MONTHLY VOLUME OF BUILDING ACTIVITY

Per cent of total year's work performed each month. Estimate based on rates of shipment of three important building materials and one building equipment item.

Immigration as Affecting the Labor Situation

By Magnus W. Alexander
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FROM 1820 until Nov. 30, 1922, altogether 34,936,599 immigrants came to the United States. The causes of this gigantic migration have been various, but more important than any others are the *economic factors*, having their root either in the lack of economic opportunity in European countries which has become even more acute with the breakdown of European economic life since the war, or in the opportunities for work and advancement which the United States has in the past held out to immigrants.

Immigration in Relation to Industry—The immigrants coming to the United States seek work in our factories and mines. By this they exert a two-fold influence: they affect our business interests and business development and they also affect the great bulk of native and foreign born workers already employed in our factories. Between 1900 and 1920 the number of wage earners rose from 4,712,763 to 9,096,372, an increase of about 93 per cent. During this same period the number of persons engaged in gainful occupations rose from 29,073,000 to 41,046,000, or 69.8 per cent. During this same period, however, the population rose from 75,994,000 to 105,710,000, or 39.1 per cent. It will be seen from this that the rate of growth of industry has exceeded that of population. The influence of immigration here is difficult to indicate with exactness but it is undoubtedly a prominent factor. Our development would probably have been retarded if our industries had not had the labor supply which immigration made available.

Economic Objection to the Immigrant—The influx of immigrants into the industrial community has met with objection. Immigrants on entry are largely untrained in industrial work. They are in the main peasants from the farms of southern Europe, fitted to do agricultural work but actually going into industries as common labor. The amount of money which they show at the port of entry is small and they need work immediately. They therefore compete with the workmen already in the United States, and since their standard of living is generally lower they are able to work for less.

The increasing demand for labor accompanying our industrial growth has, according to others, prevented the increase in wages which would have come because of the presence of the large supply of recent immigrants. The competition between the immigrants themselves and the immigrants and natives, according to some writers, has resulted in the standard of wages being fixed not by skill or family requirement but by the amount for which the lowest grade worker is willing to work. Organized labor is definitely prejudiced against the immigrant because of the steady wage competition with the organized wage earner, which the former fosters. On the other hand it has been pointed out that while the immigrant may have kept general wages from advancing, their effect in this direction has not been great, due to the expansion of industry which has given new work to new workers, the service of labor organizations in standardizing wage rates within the fields in which they are organized, and the character of the immigration itself. The immigrants come here to get money; they are mobile, going where industry requires them, and returning to Europe in hard times.

Another objection to immigration is of a different character; it is claimed that immigration by bringing in more workers than can be given employment except in most prosperous times tends to increase the margin of unnecessary workers so that the danger from unemployment is increased, and in periods of declining industry suffering is heightened.

Moreover, the immigrant is charged with having a detrimental effect upon working conditions since, as the Immigration Commission states, "when the old employees have found unsafe and unsatisfactory working conditions prevailing in mines and industrial establishments and have protested, the recent immigrant employees, usually through ignorance of mining or other working matters, have manifested a willingness to accept the alleged unsatisfactory conditions."

It is held, besides, that the immigrant is generally an inefficient worker at best. This is predicated on the ground that his inability to speak English and his high percentage of illiteracy make it impossible for him to understand instructions either in English or any printed foreign languages, so that in consequence he is more prone to accident and is on the whole less productive as a worker. The Massachusetts Commission on Immigration reports that of 489 employers questioned, 360 found the southern and central European workers less efficient than the north and western group.

Finally, the new immigrants are pointed to as an economic liability because of the large amounts of money which they send out of the country. The U. S. Immigration Commission estimated that in 1907 altogether $275,000,000 were sent out of the United States by foreign workers; of this, $85,000,000 went to Italy.

Economic Advantages of the Immigrant—Despite the economic disadvantages already pointed out, the fact is generally recognized that the industries of the United States have been built up in a large measure through the immigrant labor supply. The foreign born male in the United States is essentially here to work. The 1920 census shows that in general 89 per cent of all male foreign born whites, ten years of age and over, in the United States, are gainfully employed; in the New England and Middle Atlantic states 91 per cent of them are gainfully employed. This is in contrast with a general average of 75 per cent of the native whites so employed and 81 per cent of the negroes. In agriculture the foreign born are almost negligible, but in the mining industry they represent 35 per cent of all those gainfully employed. In the manufacturing and mechanical industries 28 per cent of those gainfully employed are foreign born and 23 per cent more are of foreign or mixed parentage. Of all foreign born workers in the United States 47 per cent are employed in the manufacturing and mechanical industries.

The fact that immigrant labor constitutes a fluid supply that comes when it is wanted and departs when labor conditions are unfavorable, makes it economically advantageous. Moreover the immigrants arrive predominantly at the working age. The census figures of 1890, 1900 and 1910 show that about 85 per cent of the foreign born are in the age groups of 16 to 64, which is

the predominant working span, whereas only about 57 per cent of the white persons of native parentage are in this group.

Social Aspects of Immigration—Whatever the importance of the immigrant industrially, however, if his presence in our society means a weakening of the fabric of our civilization the immigrant should obviously be excluded. If the immigrant cripples the machinery of democratic government, if he is mentally or morally unsatisfactory in our kind of living, if he cannot be assimilated, or if he is a burden on our social institutions, he ought obviously not to be admitted. These are matters, however, which cannot be determined with mathematical exactness.

Illiteracy is one of the things counted against the southern and eastern European in the past. The 1920 census showed that 13 per cent of the foreign born whites were illiterate as against 2.5 per cent for the native Americans. The Immigration Law of 1917 excluding those over sixteen years of age who are unable to read from thirty to forty simple words of some language has done away with an increase of illiteracy, but this test of literacy is so simple that it does not necessarily mean the ability to read and understand complicated instructions. Moreover it should be remembered that the children of foreign born in the United States show the lowest rate of illiteracy of any class in the population (0.8 per cent), which shows that the foreign born not only is capable of education but that he is eager to secure it for his family. This low percentage is due to a degree, however, to the fact that the foreign born are concentrated in the northern states where compulsory school laws exist and are enforced. The school attendance of foreign born white children is less in proportion to their number in the population than that of either native whites or natives of foreign parentage. Only 42.2 per cent of the foreign born from five to twenty years of age are in school as against 66.9 per cent of native whites of native parents and 65.8 per cent of native whites of foreign or mixed parentage.

The army mental tests are frequently cited as showing the low ratings of the southern and eastern Europeans, but these intelligence tests cannot be so used. In the words of Professors Yoakum and Yerkes, who devised the army group test, it was "not prepared for civilian use and is applicable only within certain limits to other uses than that for which it was prepared." The question of mental inferiority of the southern and eastern Europeans is but one phase of the idea that the foreigners are inferior racially and that their blood will tend to "pollute" that of the present American stock. Here again we are in a field where scientists differ and where we are only at the beginning of the research which should precede definite assertions. Students such as Professors Boas and Giddings of Columbia University, Ripley of Harvard, Jenks of New York University and Kelsey of the University of Pennsylvania hold that there is no harm in racial intermixture.

With respect to insanity and feeblemindedness, foreigners so mentally deficient have been excluded from entry into the United States since 1882. The federal censuses of insanity in 1904 and 1910 show a higher percentage of insanity among the foreign born than for other portions of the population. It is significant, however, that the nationalities most heavily represented among the insane in 1904 and 1910 were the Irish, Germans and Scandinavians. The Italians, Russians and Austrians, who in recent years have made up the bulk of our immigration, show a negligible amount of insanity. The census shows further that the native whites of foreign and mixed parentage are less liable to insanity than the foreign born, which would seem to indicate that the process of adaptation may have something to do with the unbalancing of the minds of many foreigners, and that their children who are freed from this handicap are not permanently liable to insanity.

Another charge against the foreigner is that he increases crime out of proportion to his numbers in the population, and that crimes of violence in particular have increased because of the presence of large numbers of southern and eastern Europeans. The foreign born were 28.2 per cent of the white prison population in 1890; 23.7 per cent in 1904, and 22.5 per cent in 1910. Examination of these statistics shows, however, that the native whites are responsible for more serious crimes than the foreign whites. The offences chargeable to the foreign born are mainly violation of ordinances and arise probably from ignorance of the law.

With respect to *pauperism* the statistics of 1910 show that one-third of the total number of paupers in alms houses are foreign born. The nationalities chiefly represented are the Italians and Germans, the former making up 17 per cent of the total and the latter 8 per cent. It is significant that two-thirds of the foreign born paupers have been in this country twenty years or more. Paupers of foreign or mixed parentage constitute only 12 per cent of the total number, indicating that the second generation is apparently no more subject to pauperism than are the natives. A complete record of charity cases in forty-three cities was made for the Immigration Commission by organized charity societies. The period covered ran from December, 1908, to June, 1909. Out of 31,685 cases assisted 38 per cent were foreign born and 7 per cent were cases of native born of foreign parentage. The races represented by one hundred or more cases in order of numerical importance are Germans, Poles and Irish. The percentage for Europeans of southern and eastern nativity are low in every instance.

The foreign born congregate in national groups and do not mingle with the native population, thus forming little cities within a city and having their own shops, restaurants, banks, fraternal societies and newspapers. This represents, however, a natural tendency. Americans in foreign countries in a similar way form their own colonies. Natives of any country naturally seek the closest social contact. Since most immigrants come here for the purpose of earning a living they are drawn to places where the industries are situated and thereby to the cities. In order to secure quarters at the low rent which they are willing to pay they invariably go to the districts which have been deserted by the more progressive of the older foreign and native white stock. The Massachusetts Commission on Immigration points out that the first point of contact which the foreigner makes in the United States is his home. High rents force overcrowding among those with lower incomes and bad sanitary arrangements and dirty streets make it difficult to maintain decency and health. This circumstance is closely allied with pauperism.

Political Factors—Desirable as the immigrant may

be economically, his presence here creates also a political problem, since obviously the value of residents within a country arises from their interest in its government and institutions and their participation in them. Americanization studies by the Carnegie Foundation show that the immigrant in the United States waits on an average of 6.8 years after arrival before filing his intention to become a citizen and about five years longer before filing his final petition for naturalization. In other words he takes close to twelve years on an average, whereas the law permits citizenship within a period of seven years. This, however, is taken to indicate that not until the foreigner is adjusted to his environment does he feel ready to take part in the government.

The charge of radicalism against the foreigner is difficult to judge. The foreigner tends at first to bring with him the racial and other prejudices which maintain in his native country and to see our life in terms of his past experience and environment. Figures of the average paid membership in the Socialist Party show that of a total of 81,000 members, 29,000 are foreign born. Over 9,000 of these are Finns; 5,000 are Germans; 3,000 are Jews; and 2,600 are southern Slavs. The Communist Party has 35,000 foreign born members out of a total membership of 58,000. The strength of these groups, however, is small. On the other hand it may be noted that a large number of the foreigners come to the United States because they appreciate the advantages of a democratic government.

The Operation of the 3 Per Cent Limit Act—The present law is the culmination of a movement toward greater restriction which has grown up during the past two decades, based chiefly on social considerations, reflecting the point of view of organized labor and of those who feel that immigration has raised serious social problems. It has been felt that the preponderance of eastern and southern European types in the immigration of the past twenty years has had unfavorable effects upon working and living conditions, largely due to the difficulties in assimilating these alien types. The chief idea in the limiting of immigration to 3 per cent of the number of foreign born living in the United States at the time of the 1910 census of population was that by this means the immigration of desirable races would be promoted and that of undesirable types restricted.

The law, however, has had unforeseen effects both as to the volume and character of the immigration during the first fiscal year of its operation. The number of immigrant aliens admitted during the fiscal year (1920) *preceding* the present law was 805,228, while 247,718 immigrant aliens departed, leaving a net increase of population by immigration of 557,510 persons. During the first fiscal year of the law's operation, that is from July 1, 1921, to June 30, 1922, the number of immigrant aliens admitted was 309,556, and the number leaving 198,712, making a net increase of population by immigration of only 110,844, or less than one-fifth the gain in the preceding year.

The northern and western European countries exhausted only 46.4 per cent of their quota, the southern and eastern European countries and Turkish territory in Asia exhausted 95.3 per cent of their total quota. The quotas assigned to northern and western Europe would have permitted more than half of the total immigration to come from the ten countries in that group. During 1921-1922 only 36.8 per cent of the total immigration came from this source, whereas 63.2 per cent came from the new sources. In the first group, only Belgium and Switzerland exhausted their quotas; in the second group Russia was the only country whose quota did not approach exhaustion. The act has therefore reduced the numbers coming even further than was expected by giving higher quotas to certain countries than they were likely to fill.

The effect of the law is still more striking when the racial and occupational character of the arriving and departing immigrants is studied. The largest net immigration was of English, French, German, Irish, Scandinavian and Scotch peoples, in short, of the races from which the skilled rather than the common labor of American industry has been recruited. Of the Hebrews, who are chiefly traders, rather than industrial workers, 53,524 entered while only 830 left.

Occupations of the immigrants are as follows:

No occupation	131,050
Miscellaneous occupations (including 32,726 laborers)	115,963
Skilled workers	51,588
Professionals	10,955

During the same period the emigrants departing were classified as follows:

No occupation	54,944
Miscellaneous occupations (including 100,058 laborers)	122,497
Skilled workers	17,958
Professionals	3,313

The classification of a departing emigrant is based on the occupation followed while in this country and is not entirely comparable with the occupation classification of an immigrant. Yet it is significant that nearly three times as many laborers left the country as came in and that, including all skilled and miscellaneous workers, there was only a net increase of 27,096. These figures present a decided contrast to the figures for the pre-war period covering the years from 1909-1910 to 1913-1914. The proportion of persons without occupations has greatly increased. The proportion of farm laborers has greatly decreased. The net immigration for the four main working groups (skilled workers, unskilled workers, farmers and miscellaneous occupations) has decreased from 517,618 to 27,096.

Comparing the number of immigrants admitted with those departing, we find that there was a net gain of only 6,518 males and 104,334 females. The number of persons between the ages of 16 and 44 departing represented over 60 per cent of the number admitted. The largest percentage gain was in the group under 16.

When the 3 Per Centum law was put into effect the difficulties of administration increased rather than diminished. The immigration officials seem to think, however, that there will be less trouble in the future now that the steamship companies have been taught the danger of bringing immigrants in excess of the quotas and now that the countries of Europe are exercising more care at the ports of embarkation. There have been numerous instances of great injustice and hardship in individual cases. Many of them were due as much to the difficulty of administering the law as to the discrimination in the law itself.

The most definite point upon which the immigration law is now being questioned concerns the present condition of the labor market. It is here that the effect of restriction is likely to be most noticeable after a single year's operation. The effects on assimilation and naturalization, on the other hand, cannot be accurately gaged after so short a period.

Outstanding Features of Western Water-Power Development in 1922

Forward Steps in Design and Construction—A Stabilized Tendency Toward Municipal Ownership or Control—Economic Aspects of the Western Water-Power Situation

MORE than any previous year 1922 stands out as a year of water-power development in the West. The amount of construction under way has been very large, important projects have been launched or completed, new high-voltage records have been made, and all lines of business identified with hydro-electric development have felt the stimulus of busy times. In such a period of activity and concentrated thought, it is natural that progress should be made. There have been important improvements in details of waterwheel design—such as the invention of rubber seal rings for reaction turbines—and at least one new departure has been suggested affecting the application of fundamental hydraulic principles; namely, the experiments with turbo-type impulse runners.

In the construction field there has been a full measure of progressive ideas. Typical of these are (1) the two masonry dams, completed this year in California, in the construction of which concrete aggregate containing rock up to 14 in. in length was put through the mixer; (2) an economical system of handling bulk cement used on the Hetch Hetchy Dam; and (3) a portable, self-contained piece of apparatus for placing concrete lining in long power tunnels which is taken into the tunnel and moved along as the work advances, carrying with it facilities for storing materials, a concrete mixing plant and a "gun" for delivering concrete by the pneumatic process.

A table published in *Engineering News-Record*, Jan. 5, 1922, p. 25, lists twenty-eight Western water-power projects that were under way at that time or definitely projected for development in the near future. The total capacity of the plants there listed amounts to about 1,500,000 kw. Taking each kilowatt as representing an investment of about $300, when substations and distributing systems are included, the total investment represented in that list of projects is about $450,000,000. This figure, which represents current work alone, indicates (1) the potential power demand, (2) the extent to which capital is essential to and (3) the extent to which capital is already interested in the Western situation.

Taken as a whole, the outlook in the water-power field in the West is very promising; the rush of construction activity that followed the 1915-1920 period during which practically no water power was developed, has now ceased, but on the other hand the several large companies have adopted the policy of programing their work five to ten years ahead and this is sure to have a stabilizing effect on the construction field. More detailed comment on some of the outstanding features of the Western water-power situation is presented in the following:

Extensive Power Development in 1922—Water-power projects under way during 1922 in the Pacific Coast states amounted to about 70 per cent of the total for the entire United States. So far as known, none of the projected developments listed in the *Engineering News-Record* table referred to in the foregoing has been postponed and a few more have this year been added to the list. Some of the plants not included in that table but which are now scheduled for construction in 1923 are listed in the accompanying table.

RECENTLY COMPLETED PLANT NO. 1 ON THE PIT RIVER
Discharge from top of cylindrical surge chamber at head of penstock line causes the waterfall at the right.

New Features In Design—The experience of the year is in keeping with the reputation which the West enjoys as a prolific source of new ideas in design. The development of rubber seal rings for reaction turbines (*Engineering News-Record*, Nov. 9, 1922, p. 789) greatly extends the range of application for units of this type in comparison with impulse wheels by removing some of the principal drawbacks to the reaction type, namely, wear of seal rings, leakage and loss of efficiency. In short, the advent of this improvement is expected to put reaction turbines in a new and more favorable light in selecting the type of wheel best suited to given conditions. Experiments with the turbo-type impulse runner (*Engineering News-Record*, Oct. 26, 1921, p. 707) indicate that this departure from long-established standards will put on the market a type of impulse runner embodying some of the chief advan-

SOME OF THE MORE RECENTLY STARTED PACIFIC COAST POWER PROJECTS

(These are in addition to those listed in the *Engineering News-Record* table published January 5, 1922, p. 25.)

Name or Location	Company	Capacity* (Horse Power)	Static Head (Feet)
At Ocean Falls (British Columbia)	Pacific Mills, Ltd.	6,300	140 (average)
On Hood River (Oregon)	Pac. Power & Light Co.	8,700	150
El Dorado Plant (American River, Cal.)	Western States Gas & Electric Co.	28,000	1,960 (approx.)
On McKenzie River (Oregon)	City of Eugene, Ore.	2,000	50
Fourth Unit at San Francisquito No. 1 (Los Angeles Aqueduct)	City of Los Angeles	16,000	940
San Gorgonio River, Unit No. 1 (near San Bernardino, Cal.)	San Gorgonia Power Co.	2,330	1,775
San Gorgonio River, Unit No. 2 (near San Bernandino, Cal.)	San Gorgonia Power Co.	1,030	900
Third Unit, Big Creek No. 1	So. Cal. Edison Co.	21,300	2,131
**Oak Grove Plant	Port Ry. L. & P. Co.	35,0	960
Bullard Bar Plant	Yuba Development Co.	9,000	175
Exchequer Plant	Merced Irrigation Dist.	35,000	310

* Capacity given is that for units being installed at present.

** Notable change in size and head since last year's table was published. (35,000 hp. in one Francis turbine under record head of 960 ft.)

tages of the reaction type. This will aid in the provision of equipment suitable for heads between 800 and 1,000 ft., as well as in other ranges where designs thus far available have not been all that could be desired.

Results in the operation of the reaction turbines under the record head of 806 ft. at the Kern River No. 3 plant of the Southern California Edison Co. have been highly satisfactory and it is doubtless due in large measure to their success that the Oak Grove project in Oregon will use a 35,000-hp. reaction turbine designed for a head of 850 ft. Experience with that installation in turn, may be expected to lead to the use of reaction wheels under still higher heads.

The record-size, double-runner impulse units in the Caribou plant of the Great Western Power Co. have been developing 32,500 hp. under a 1,008-ft. head since the plant was started a year ago. This experience will be helpful when occasion arises for the construction of similar units under higher heads. High heads are not uncommon in modern practice—two plants with static heads exceeding 1,700 ft. are now under construction in California—but only infrequently is there occasion to use very large units under such high heads.

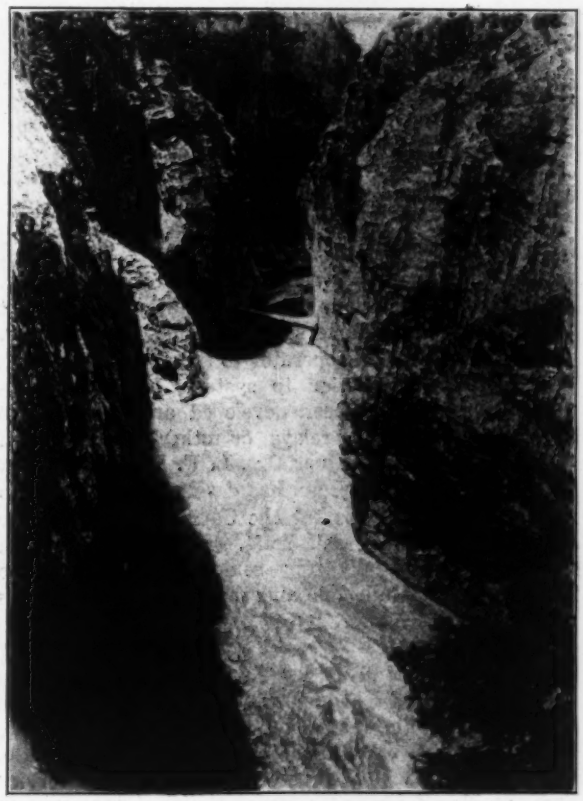
Progress in 1922 has not been limited to the hydraulic units; originality and ingenuity have been manifest in many other parts of recently constructed projects. The surge chamber on one plant finished this year has a circular spillway, 30 ft. in diameter, from which the overflow is gathered in a circumferential trough; on another project an 800-sec.-ft. flume is designed to spill over both sides, the overflow on the uphill side being carried beneath the flume to join the waste-way from the opposite lip; on still another job an earth dam is being built by both hydraulic-sluice and dry-fill processes simultaneously—the two methods being used on opposite sides of a concrete core wall which is "articulated" by numerous vertical and horizontal joints.

Tunnels under pressure are not avoided where they are necessary to economy in construction; the Newhalem plant in Washington is served by an unlined tunnel whose lower end, with an overburden of less than 100 ft. of rock, is under a head of 250 ft. The Gorge plant on the Skagit project, now under construction by the city of Seattle, will have a tunnel subjected to a maximum head of 380 ft.

Siphon spillways have gained popularity rapidly and their use now ranges from the largest dams down to canals that serve forebays.

Progress In Dam Construction—Prominent in the past year's practice in the construction of large masonry dams is the use of coarse concrete aggregate in lieu of plums. Lively discussions have resulted on the comparative advantages and costs of the two methods. Local conditions will always govern, of course, but experience at Don Pedro and Barrett dams indicates that coarse aggregate is worthy of being considered more frequently in planning massive concrete works.

At Don Pedro Dam (*Engineering News-Record*, June 1, 1922, p. 896) water worn boulders up to 14 in. in



DIABLO DAM SITE ON SEATTLE'S SKAGIT PROJECT

maximum dimension were put through the mixers. On the Barrett Dam (*Engineering News-Record*, July 27, 1922, p. 157) crushed quarry rock of similar maximum size was successfully put through the mixer. By occasionally replacing vanes in the mixers and liners in the spouting chutes, even with the sharp corners of crushed rock the wear was not prohibitive nor was there unusual difficulty in mixing and delivery.

The economy of handling cement in bulk on the Hetch Hetchy Dam (*Engineering News-Record*, March 2, 1922, p. 352) suggests the more extensive use of this plan wherever it can be employed. While manifestly unsuited to small jobs, on large work bulk cement affords a two-fold advantage and a reduction in common labor requirements. With labor conditions as they have been in recent years the latter advantage is perhaps the more important.

Any dam 500 to 700 ft. high would command world wide attention and from the standpoint of both design and construction there is a lively interest in the dams

now being proposed for the Colorado River. Plans have been brought forward for earth, loose rock, masonry and multiple arch designs for storing Colorado River waters, in each case with logical reasoning in favor of the particular type proposed. Among these is the interesting scheme for a multiple-arch type of unusual design some 400 ft. high.

An investigation of arch dams that has recently been undertaken by Engineering Foundation will probably be of special importance in Western power development. In these studies, arrangements for some of which have already been made in the West, it is hoped that by measuring and analyzing deflections, stresses, temperatures, etc., in existing structures and also in test dams to be built for this special purpose, a safe and reliable basis may be established for building arch dams of more economical construction.

Radio Aids Construction and Operation—Two Western companies—the Southern California Edison Co. and the San Joaquin Light & Power Corporation—are now carrying on construction work in which radio is successfully taking the place of the telephone or telegraph wire for all communication. In itself this is not unique, but it has led to a very important application of radio in hydro-electric operating practice, namely, the use of transmission lines as carriers or guides for radio waves. By this means the remote generating station may be kept in touch with headquarters independently of wire lines.

Means of calling the operator to the apparatus, which meet a serious objection to systems heretofore proposed, have recently been developed and can now be accomplished without relays or other sensitive and easily deranged apparatus. Dr. L. F. Fuller, with but little precedent to work on, has developed carrier radio communication systems for the Caribou and Pit River transmission lines in California. The former has been operating successfully for some months over the 110,000-volt, 200-mile line and the Pit River system is now being installed.

220,000-Volt Transmission Line—Power lines of the Pacific Coast are retaining their lead in both voltage and length. This year steel towers of the 250-mile, 150,000-volt line of the Southern California Edison Co. are being raised 10 ft. without interruption to service and the plan is to raise the voltage on this line to 220,000 volts. Voltage on the 200-mile Caribou line is to be raised from 110,000 to 165,000 volts this year and the 200-mile Pit River power line recently completed by the Pacific Gas & Electric Co. will be operated at 220,000 volts.

The interconnection of high-tension transmission lines along the Pacific Coast has been continued so systematically that when a connection now under way at Springfield, Ore., and another to bridge a gap of 100 miles in Eastern Oregon are completed there will be a continuous system from British Columbia to the Mexican line. From the northernmost generating station on this system to the Mexican border, the shortest route along this interconnected transmission system will be about 2,000 miles.

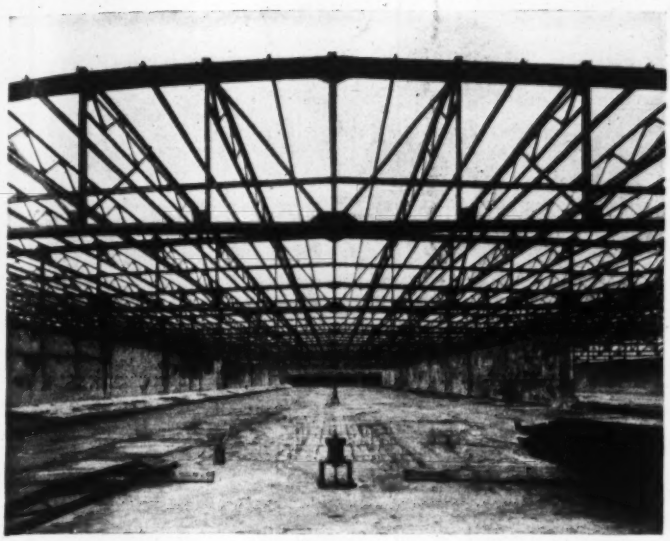
Programing Development Ten Years Ahead—The present-day policy of Western power companies is to lay out their construction program for five to ten years in advance. This has the advantage that efficient construction forces can be organized and maintained and the high cost of rush construction can usually be avoided. There are still greater advantages, however, in the co-ordination of financing, purchasing, operation and sales departments. In fact, a more or less flexible program and yet one which proposes definite lines of extension for years to come is a decided advantage to all departments.

Governmental Interest in Water Power—In its political aspects the Western water-power situation is complex. On every large development, such as those on the Colorado and Columbia rivers, the question of securing the approval and perhaps the financial support of the federal government has always been considered, but federal influence has been potential rather than active. Of late the federal government has become a more active factor; not only has the Federal Power Commission been carrying on work of a departmental and supervisory character affecting all undeveloped sites, but the Colorado River Commission, another federal agency, has taken the initiative in calling together representatives of seven Western states to co-operate in establishing and to agree upon a definite policy in allocating the benefits to be derived from the Colorado.

Municipal Ownership of Water Powers—With Hetch Hetchy and Skagit power projects well under way, San Francisco and Seattle, respectively, are developing their own sources of power; while Los Angeles has been partially served for some years by municipally owned plants. In addition to these three largest coast cities numerous smaller communities have taken steps in the same direction. This condition has come about in answer to a popular demand for municipal ownership.

However, where there is progress and more or less freedom from precedent, there is attractive opportunity for the radical, and to deal firmly with radical schemes without closing the door to originality and to worthy development along new lines has been an ever present Western problem. An example in point was the State Water and Power Bill submitted to California voters on the November ballot. This measure, discussed editorially in *Engineering News-Record*, April 27, 1922, p. 676, proposed what was without question the most radical experiment in state development and ownership thus far brought forward in this country. Municipal ownership on a sane basis has doubtless come to stay, but that the trend in that direction is not to be stampeded and that reasonable restraint and regulation may be expected, is indicated by the defeat of this measure by a majority of more than two to one.

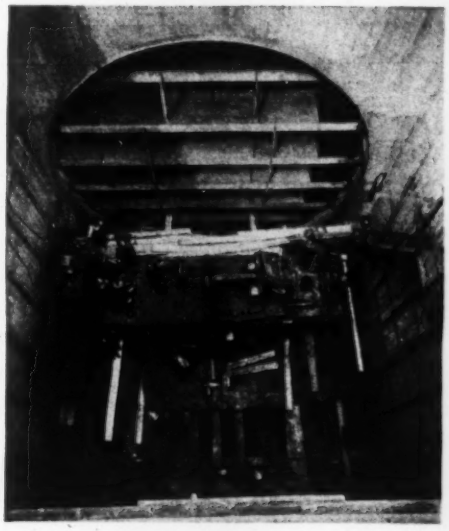
The question of whether the trend to municipal ownership will at some later time swing beyond reasonable limits and so make the West, for a time, playground for radical and political experimentators, will have an important bearing on the financing of future power developments. Industries are attracted by abundant power at reasonable costs and without power industrial communities do not progress. The future of the West, therefore, is closely interwoven with power development which in turn hinges on the availability of large sums of money. Where there is a fair spirit between well managed municipal systems and private power companies, municipal ownership has not been an obstacle in obtaining capital for further private development. On the other hand, where municipal ownership has led to duplication of service, rate wars, etc., with the ordinance-making and other political powers of the municipalities aligned against the private companies, capital has been discouraged.



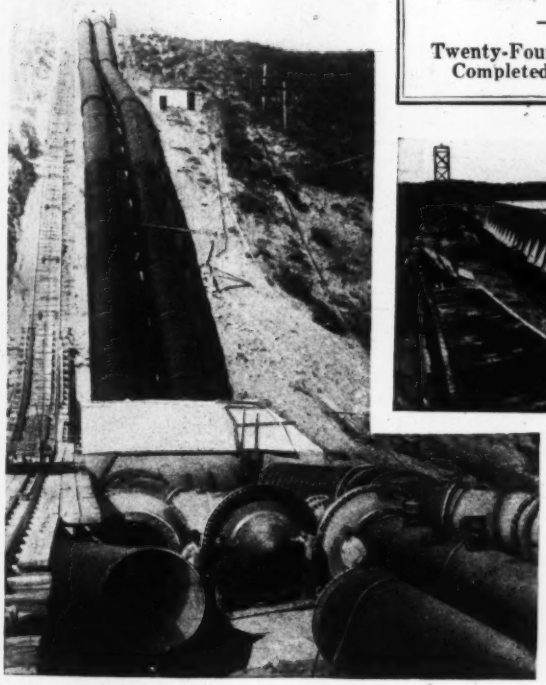
DETROIT FILTRATION PLANT
Structural-steel roof over coagulation basin.

A Pictorial Review of Engineering Construction in the United States

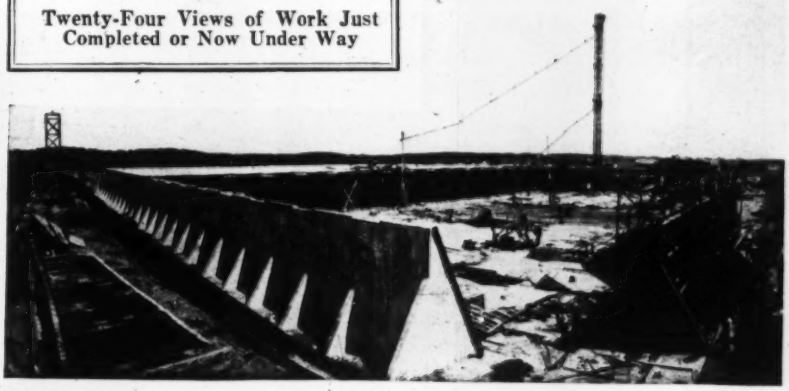
Twenty-Four Views of Work Just Completed or Now Under Way



HUDSON RIVER VEHICLE TUNNEL
Erecting shield in New York shaft. The circular opening (closed by temporary bulkhead) through which shield will leave shaft is shown in upper part of photograph.

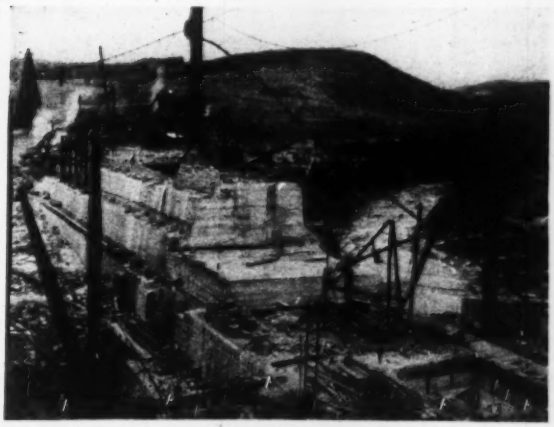


SAN FRANCISQUITO POWER PLANT, LOS ANGELES AQUEDUCT
Pipe and needle valves on penstock.

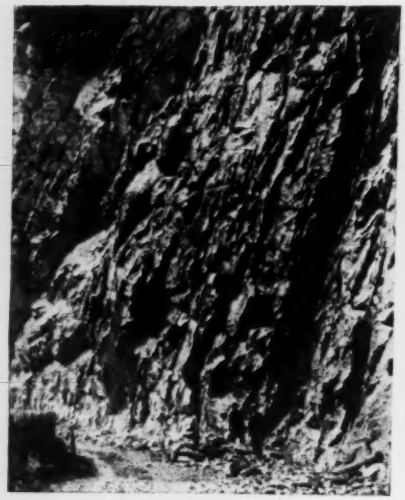


ST. PAUL FILTRATION PLANT
16,000,000 gal. low-service reservoir to carry 19 ft. of water.

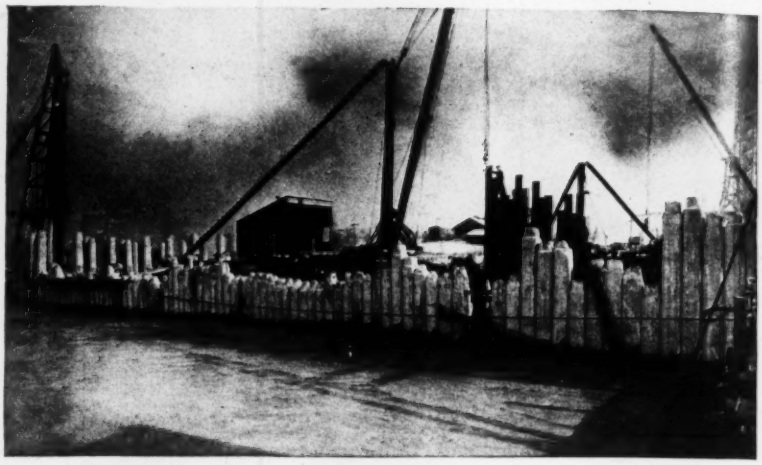
GRANT PARK STADIUM, CHICAGO
Machine grading for new municipal stadium.



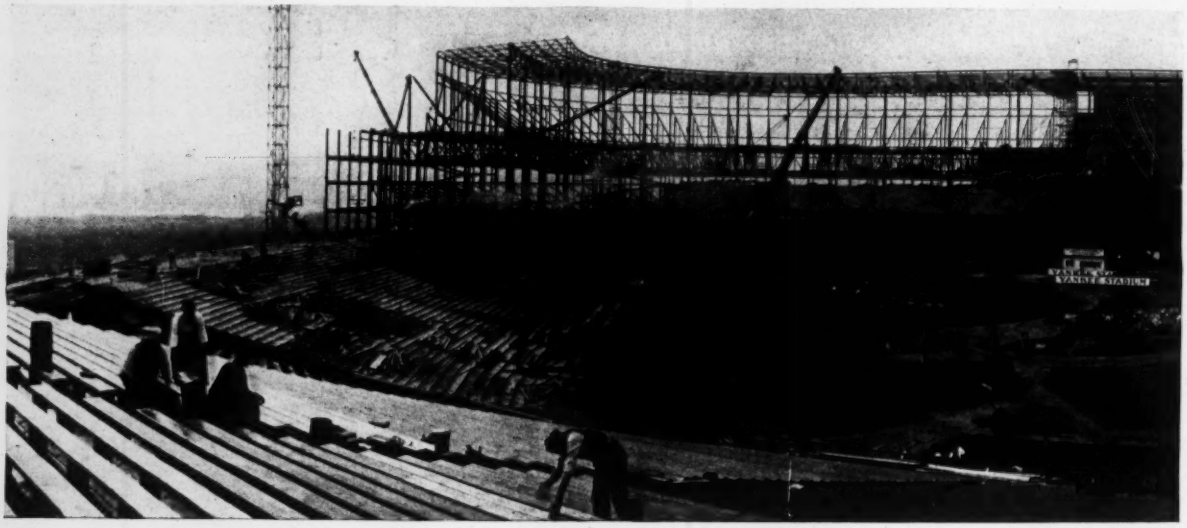
GILBOA DAM, NEW YORK CITY WATER SUPPLY
Maximum height 160 ft.; gravity masonry structure. During 1922 144,000 cu. yd. of masonry were placed, 100,000 cu. yd. of excavation done and 158,000 bbl. of cement were used.



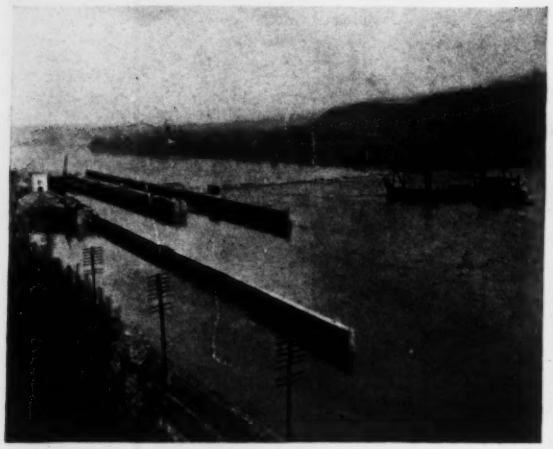
STORM KING HIGHWAY, NEW YORK
A 120-ft. cut in ledge rock around the nose of the mountain.



240,000-KW. CAHOKIA POWER STATION, EAST ST. LOUIS
Driving the cutoff wall at river face of station, employing 18 x 21-in. reinforced-concrete interlocking sheetpiles, 75 ft. long.

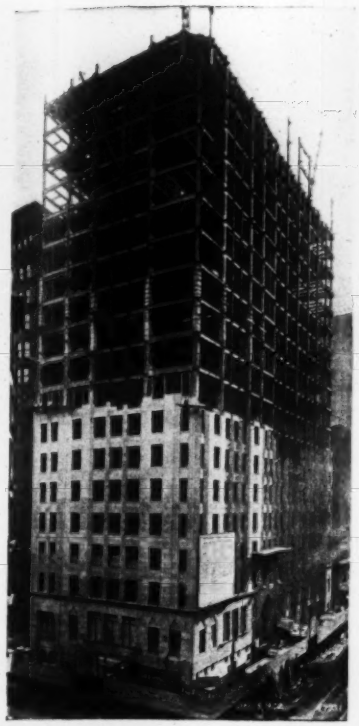


YANKEE BASEBALL STADIUM
Steel and concrete stands for the American League New York team. Half of structure shown. Wooden bleachers in foreground.



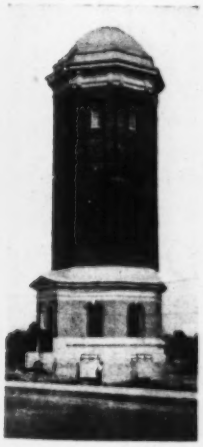
EMSWORTH DAM NEAR PITTSBURGH
New structure replaces old dams 1 and 2, and is first fixed dam to be constructed in Ohio River. Will greatly improve port and harbor facilities of Pittsburgh.

IDEAL SECTION, LINCOLN HIGHWAY, INDIANA
10-in. concrete pavement reinforced with 80 lb. of steel to 100 sq.ft.; 100 ft. right-of-way.

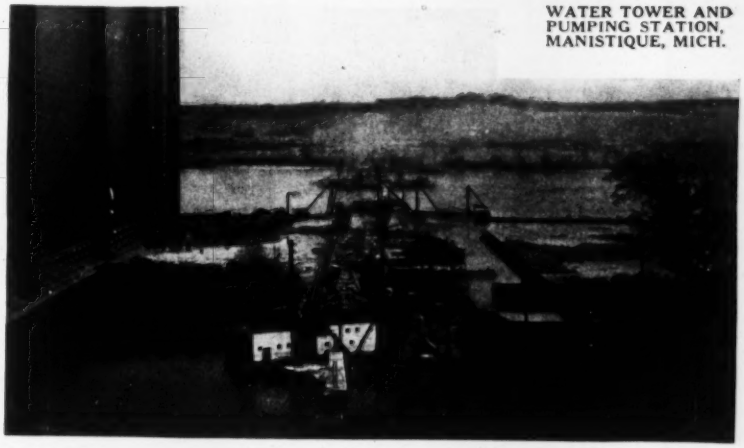


CHICAGO TEMPLE BUILDING
556-ft. skyscraper in business district to have church on main floor.

SCITUATE DAM, PROVIDENCE, R. I.
Earth fill dam for Providence water supply.

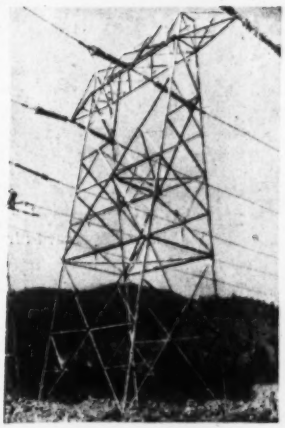


WATER TOWER AND PUMPING STATION, MANISTIQUE, MICH.

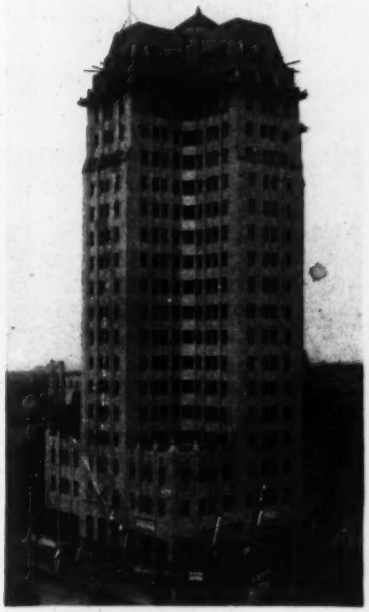


CASTLETON BRIDGE OVER THE HUDSON
Looking east from fill toward site of New York Central bridge over the Hudson below Albany.

WIDENING ROOSEVELT ROAD, CHICAGO
New concrete structure doubles width of existing street over railway tracks.

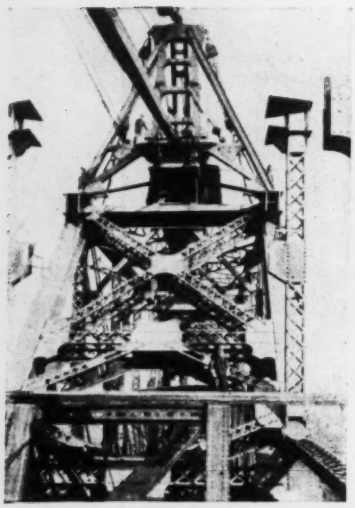


SNOW TOWER FOR 200,000-VOLT TRANSMISSION LINES
Pacific Gas and Electric Co., Pit River project.

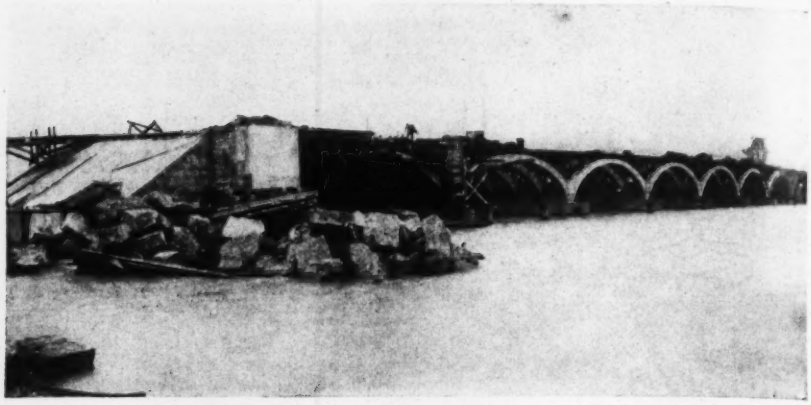


MEDICAL ARTS BUILDING, DALLAS, TEX.
Reinforced-concrete structure 255 ft. from basement to roof.

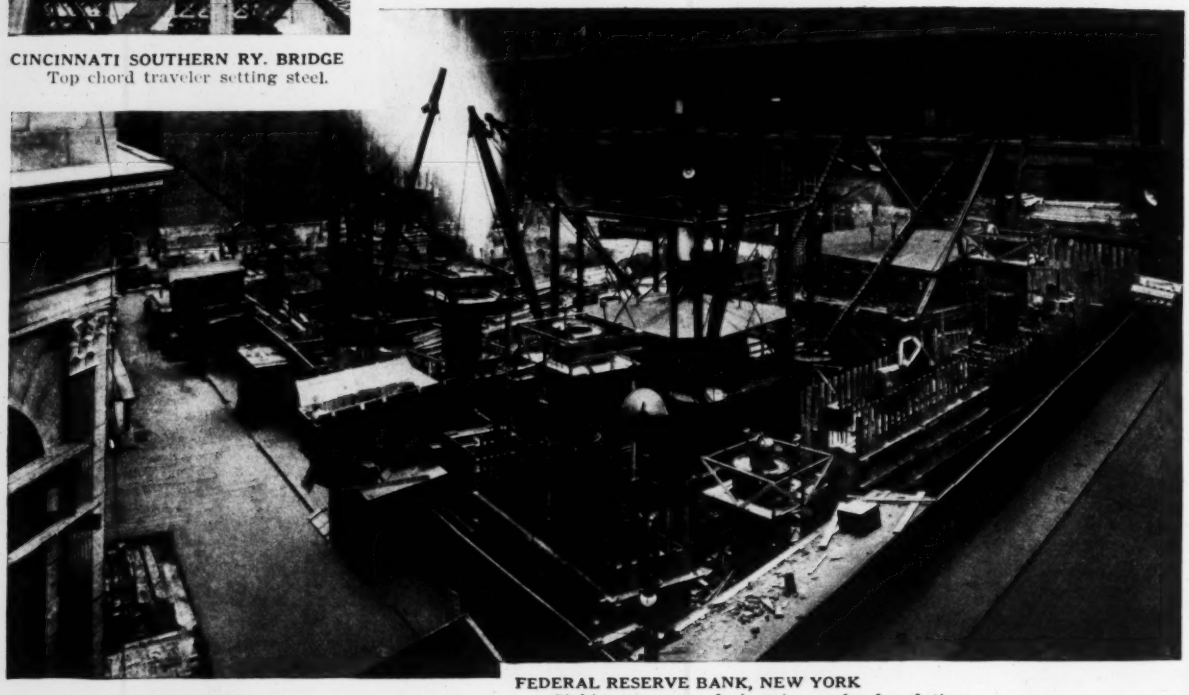
MARICOPA COUNTY CONCRETE ROAD
25 two-batch cars carrying concrete on industrial railway near Phoenix, Ariz.



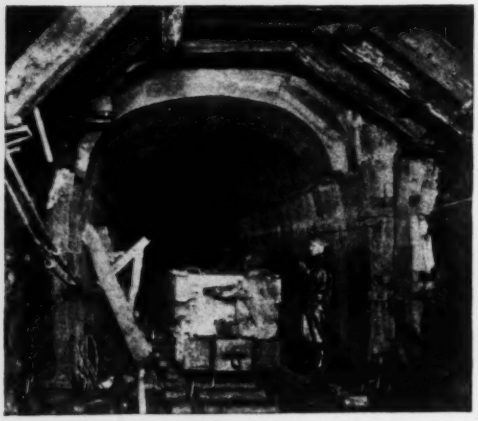
CINCINNATI SOUTHERN RY. BRIDGE
Top chord traveler setting steel.



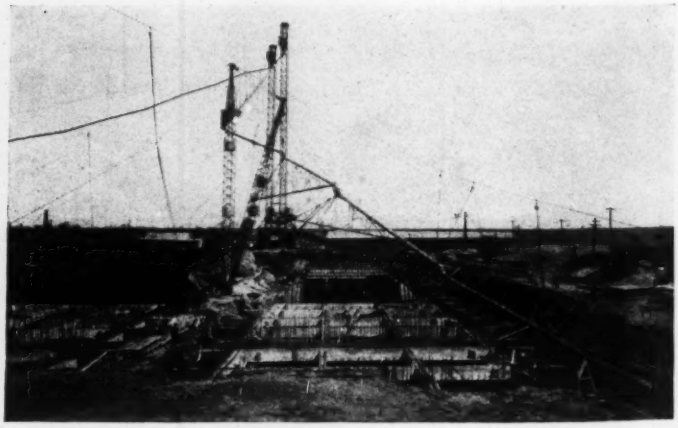
BELLE ISLE BRIDGE, DETROIT
Cantilever arch structure rapidly nears completion.



FEDERAL RESERVE BANK, NEW YORK
Sinking compressed-air caissons for foundation.



18-MILE SHANDAKEN TUNNEL
Under construction to augment New York City's Catskill water supply by utilizing flow from Schoharie watershed, 100 miles north of city.



PHILADELPHIA SEWAGE WORKS
Building Imhoff tanks by gravity chuting.

The Mississippi Problem in Light of the 1922 Flood

Arguments Favoring Spillways on Lower River and a Defense of the Levee System—To be Followed by Hydrologic Records of Floods on the River

In May and June of 1922 the Mississippi River below Cairo rose to the highest levels in the history of the river. Following the subsidence of the water there were many demands for a new study of the flood protection problem and several authoritative expressions of disagreement with the established method of control, that is, by levees. The most generally expressed demand was for spillways in the lower river, namely in the vicinity of New Orleans. The following series of articles is intended to eliminate this phase of the river control problem. They comprise, first, the argument for the spillway by a group of New Orleans engineers and second, a defense of the Mississippi River Commission's established method of control and an argument against the spillway by probably the leading authority on the river, Col. C. McD. Townsend, long president of the Mississippi River Commission. A third article giving the hydrologic record will appear in an early issue.

New Orleans Engineers Recommend Spillways Near City

AN ENGINEERING sub-committee of the "Safe River Committee," composed of 200 men from New Orleans and vicinity, has prepared and circulated a report on the Mississippi control situation as it affects the lower river. This is in effect a plea for spillways and a condemnation of the policy of the Mississippi River Commission to resort to levees as the sole means of protection. The committee was composed of John Klorer, city engineer of New Orleans, *chairman*, Prof. W. B. Gregory, of Tulane University, A. M. Shaw, consulting engineer, J. P. Kemper, civil engineer, Hampton Reynolds, general contractor and Allison Owen. The main part of the text is as follows:

The engineers forming this sub-committee are all members of this community, and all have the welfare of the city and state at heart. All have the highest regard for the ability of the Mississippi River Commission and the Engineer Corps of the U. S. Army. Some of the members of the committee have, in the past, firmly believed in the methods of control of the Mississippi River as advanced by the Mississippi River Commission, and have subscribed to the policy of "levees only" until the occurrence of the recent high water, while one, at least, for many years has advocated spillways as a method of relief.

Due to the peculiar conditions that obtained during the flood of 1922, more fully described hereafter, doubt has developed in many minds as to the soundness of the policy of "levees only." A study of the data has presented arguments in favor of a spillway for the protection of New Orleans that are apparently unanswerable. The problem is a large one, and only a limited amount of time has been available, due to individual duties and the brief period in which this report must be prepared. It is presented, therefore, as embodying our findings with present knowledge and with the assurance that our minds are open to conviction if errors can be shown in the data or the deductions.

High Water Records Over-Topped—The history of high waters in Louisiana has been one of recurring record-breaking floods. Unlike St. Louis, the metropolis of the upper Mississippi, we cannot look into the past as far back as 1844 for our highest water record. It seems that each eight or ten years the highest water record at this end of the valley is superseded by a new high-water elevation. When it became known in 1914 that the Mississippi River Commission had finally concluded as to what was going to be the ultimate high water, the people of Louisiana took heart at the prospect that the upward tendency of levee grades had finally come to an end. Their disappointment can therefore be imagined when the rising tide of the 1922 flood not only obliterated the 1912 highest water records, but overtopped the "ultimate high water" elevation from 0.5 ft. to 1 ft. at Natchez, Red River Landing, Baton Rouge and Plaquemine, and certainly would likewise have overtopped it at Donaldsonville and New Orleans, except for the lowering effect of the crevasses below the city. But what was more disconcerting was the fact that the record breaking stages on the lower river were attained this year, notwithstanding a stage of 1 ft. below the previous record at Cairo, and 4 ft. below the record at Memphis, and 2 ft. below the record at Helena and 15 and 20 ft., respectively, below the record at Louisville and Cincinnati on the Ohio. It must be concluded therefore that insofar as future floods are concerned, the 1922 flood height can by no means be considered as the ultimate high water elevation.

Channel Not Enlarged—There seems to be no doubt on the point that the expected enlargement of the channel of the Lower Mississippi has failed to materialize. The most ardent advocate of the levee system is hard pressed, after two decades of the application of the levee theory, to prove that the river has not even lost some of its cross-section area. It is true there has been some increase in the river discharge at Carrollton during the period referred to, but this increased discharge is wholly attributable to the increase in gage height and slope, and not to any enlargement of the bed of the river. This statement admits of no argument, for the 1,000,000 sec.-ft. that passed the city with the gage reading 16 ft. 25 years ago, still passes the city at no lower reading on the gage.

The committee believes that there is no part of the Mississippi River from Cairo to the Gulf upon which the confinement theory can be said to have been given a fairer trial than that part of the river from Baton Rouge to the Forts. The cross-section, to begin with, was more ideal than that of the upper river, and the channel-enlarging effect expected from levees should have been more pronounced in this section of the river, on account of the practically uniform and comparatively close distance from the edge of the bank at which these structures have been erected. Yet, recent high waters, those of 1920 and 1922 show, if anything, an impairment of the discharge capacity and this year with the highest water of record, we find that the maximum discharge quantities of previous floods have not even been equalled. (Fig. 1).

The community is therefore confronted with the stubborn fact that the provision for passing greater river discharges must be made by either increasing the high water cross-sectional area of the river through raising the levee heights, or by providing lateral openings in the shape of spillways controlled to operate only at a certain agreed upon elevation of the river.

Approved Grade Too Low—Your committe believes that the present Mississippi River Commission grade is not sufficiently high to protect the city adequately against future floods. This grade is equivalent to 25 ft. on the Canal St. gage. Had there been no crevasses and had there been unfavorable winds it is likely that the 1922 high water reading in front of New Orleans would have been nearly 24 ft. on this gage instead of 22.7. A margin of 1 ft. between the

approved grade and a deduced water line of a past flood is not considered sufficient freeboard to afford protection against floods of the future.

Difficult to Build Levees Higher—If protection is to be afforded by levees alone, then the consequent raising of the levee grade above the present approved Mississippi River Commission grade, brings us face to face with a problem in construction already beginning to make itself noticed on the lower river.

There is no lack of evidence that the supporting power of the soil along the river banks from New Orleans down and even for a distance of 30 or 40 miles above the city, is being tested nearly to its load limit by the size and weight of the present levees erected on these banks. There has not been a

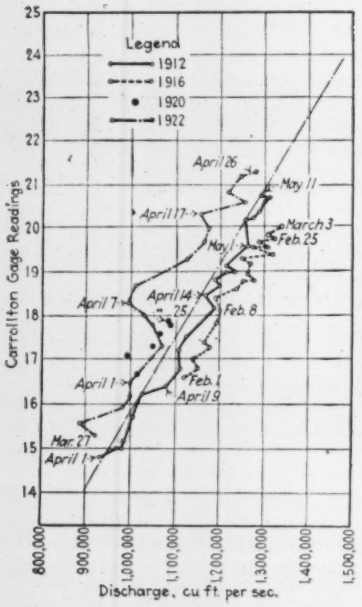


FIG. 1. GAGE-DISCHARGE AT CARROLLTON

Showing observations on the Mississippi for floods of 1912, 1916 and 1922.

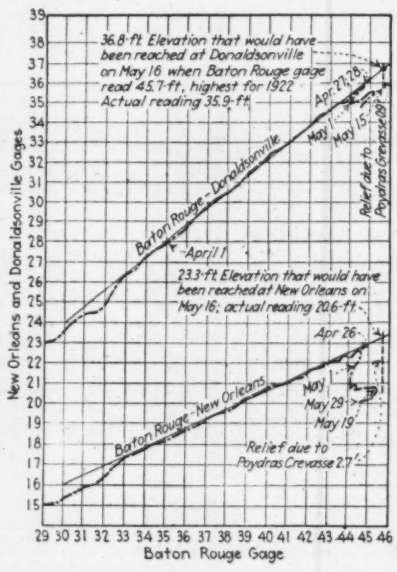

36.8-ft Elevation that would have been reached at Donaldsonville on May 16 when Baton Rouge gage read 45.7-ft, highest for 1922 Actual reading 35.9-ft
Apr 27
May 15
Relief due to Poydras Crevasse
Baton Rouge - Donaldsonville
April 1
23.3-ft Elevation that would have been reached at New Orleans on May 16; actual reading 20.6-ft
Apr 26
May 1
May 29
May 19
Baton Rouge - New Orleans
Relief due to Poydras Crevasse 2.7'
New Orleans and Donaldsonville Gages
Baton Rouge Gage

FIG. 2. EFFECT OF POYDRAS CREVASSE ON NEW ORLEANS GAGE

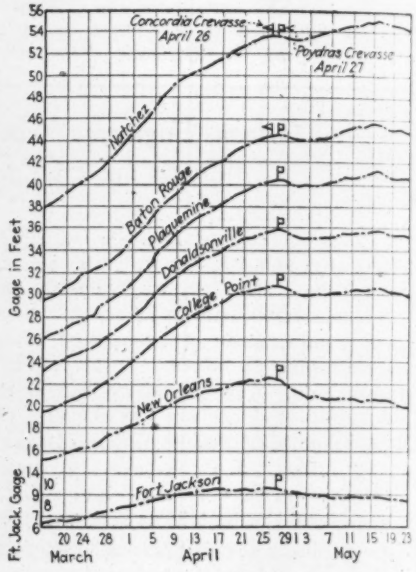


FIG. 3. HYDROGRAPHS OF 1922 FLOOD ON LOWER RIVER

Lower dotted line in Fig. 2 is Baton Rouge gage plotted against New Orleans gage. Lower full line is slope of this gage-relation before Poydras break. Theory advanced that if break had not occurred New Orleans would have been 23.3 gage on May 16 instead of 20.6, difference of 2.7 ft. being relief due to break.

new levee erected in the past ten years within the above limits that has not shown indications of settling foundation.

The records of the Board of State Engineers show that as the natural elevation of the ground decreases, the sustaining power of the soil also decreases and although a levee 20 ft. high may be built without subsidence when the ground surface is, let us say 25 ft. above Gulf level, a levee 12 ft. high cannot be built where the ground surface is 5 ft. above Gulf level without experiencing two or three feet subsidence during construction and continued slower subsidence thereafter. How aggravated this physical condition may become in future levee construction when building to a grade of say 3 ft. higher than the present grade, or how critical such a tendency to subsidence may become in times of high water due to an increment of saturation added to the embankment resting on a softened base or foundation "must give us pause."

Foundation Defects Disclosed at High Stages—The higher floods for which provision is to be made with the higher levees of increased section, often disclose foundation defects for which no provision has been made nor can well be made. To illustrate: the Ferriday levee on Lake Concordia, which failed this year through a foundation defect, showed no weakness in the previous high water when the Natchez gage read 53.5 ft. but "blew out" when the same gage read 55 ft. The foundation under the Hymelia levee that broke holding out 10 ft. of water it may be closed at a great expense; if there is 15 feet of water it cannot be closed at any expense because the time necessary to complete a structure adequate for the purpose would exceed the usual time taken for the river to get back within its banks.

With the above facts before us—being developments of a levee system with progressively higher grades—it is necessary and important that a flood relief device for lowering flood heights should invite attention and study.

Relief from Poydras Crevasse—The committee believes that the oft-expressed statement that "the relief in flood height afforded by crevasses is negligible and local in extent," was not borne out in the case of the Poydras crevasse, which in width and volume could hardly be classed with such crevasses as Belmont or Nita, or the later Hymelia, but on account of discharging practically into tide level, caused a reduction in flood height, actual and in prospect, of nearly 3 ft. at New Orleans within a period of two weeks. (Fig. 2.) The committee furthermore believes that the lowering effect of the Poydras crevasse on river gages instead of being local is traceable as far up the river as Donaldsonville and as far down the river as Fort Jackson, a combined length of river of 160 miles.

The committee believes that there is room for doubt in the generally accepted statement that the sedimentary material carried in suspension is at all times to the limit of the river's capacity to so carry material. This is an assumption that the opponents to the spillway theory have used with telling force in discussing this question, the line of reasoning being as follows: The operation of a spillway will cause steeper slopes and greater velocities in that part of

the river above the spillway and flatter slopes and slower velocities in that part of the river below the spillway; That the silt-transporting power of a stream varies as the sixth power of the velocity, consequently any reduction in slope is followed by a reduction in velocity and will cause a reduction in the silt-transporting power of the stream to a surprising degree, with the result that material carried in suspension is deposited in the main channel below the spillway and in a short time will form a bar or will reduce the cross-section of the river below the spillway to such an extent that the cross-section area of the river below the opening plus the area of the spillway will be no greater than was the area of the river before the spillway was constructed.

It is acknowledged that if such were the case, namely, that if the slightest reduction in the velocity of the main stream would cause a deposition of the sedimentary matter carried in suspension, then it would be futile to pin any hopes of getting permanent relief by means of a spillway.

Silt Carrying Data—In the absence of any readily available published data bearing upon this important point, your committee consulted the records of the New Orleans water purification plant where daily observations are made of the turbidity of the raw water, and has platted results which it is believed will be interesting to students of the Mississippi River. (Fig. 4.) The intake of the pipe to this plant is located at the lower end of the mattress-protected Carrollton Bend at an elevation of about 4 ft. below low water elevation, and the pipe is carried on a trestle extending more than a hundred feet beyond the shore line. The samples taken from a pipe located as above described, are

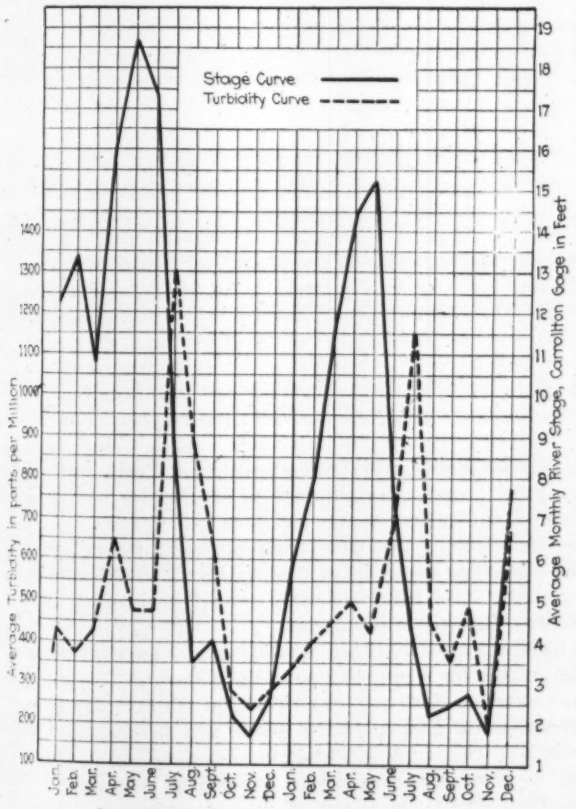

Stage Curve
Turbidity Curve
Average Turbidity in parts per Million
Average Monthly River Stage, Carrollton Gage in Feet
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

FIG. 4. TURBIDITY STAGE ABOVE NEW ORLEANS

To show that turbidity in river at New Orleans waterworks intake has no relation to stage.

believed to be fairly representative of the condition of the Mississippi River water with respect to its content of suspended material.

The chart shows that contrary to prevalent opinion there is no direct ratio between the higher gage heights and the degree of turbidity of the water during floods and the impressive fact is that the maximum turbidity in flood years occurred when the Carrollton gage was less than 14 ft. Therefore if the river is capable of carrying in suspension its maximum load of silt with slopes such as it has at

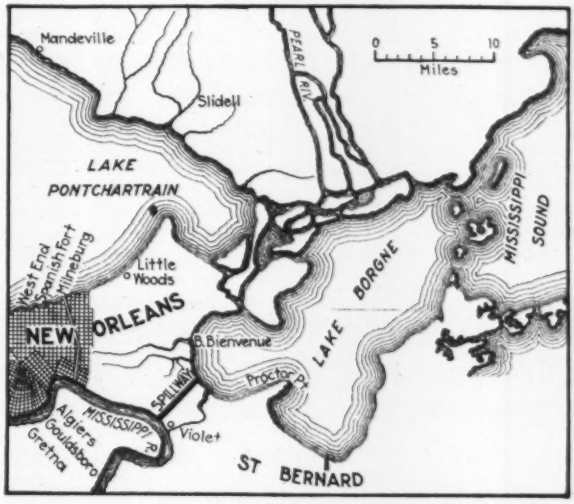


FIG. 5. PROPOSED LAKE BORGNE SPILLWAY

stages 6 or 7 ft. below the maximum height, the fear that it may drop its sedimentary load as a result of lowering its height below the spillway may justly be questioned.

The committee is of the opinion that unless it can be demonstrated as a fact by measurements that a shoaling has occurred below the Poydras crevasse which cannot be removed by the ordinary flood stages of 16 ft., or less, the spillway project recommends itself and presents no difficulties in construction that cannot be overcome within reasonable cost.

Proposed Spillway—To obtain the greatest benefit for New Orleans such a structure should be located as near as practicable to the city. Three locations were discussed, (a) one above the city discharging into Lake Pontchartrain, (b) one below the city, on the west bank, discharging in the bayous and bays to the west of the Mississippi, and (c) one below the city discharging into Lake Borgne.

It was recognized that a spillway of proportions ample to afford the desired relief if located above the city and discharging in Lake Pontchartrain would involve the greatest disturbance to existing lines of communication entering the city from above, and would complicate the drainage of all that territory located between the river and the lake raising the level of Lake Pontchartrain several feet. The hazard of overflow in the rear of the city in the event of a storm while the spillway was operating was also an adverse condition to be reckoned with.

A location (Fig. 5) six miles below the Barracks, on the city side discharging into Lake Borgne which is an open body of water connecting with the Mississippi Sound, was most favored, on account of its short direct route being slightly over five miles, the absence of any complicated disturbance to drainage conditions, a minimum interference with rail or vehicular communication with the territory below, and finally on account of this location involving the least cost. It was also noted that at this location the present cross-section of the river is approximately 10 per cent in excess of the cross-section of the river at Carrolltor and could therefore stand shoaling to some extent should such a condition materialize following the operation of the spillway.

As to tentative dimensions and capacity, the committee suggests a width of 6,000 ft. with a discharge of 250,000 sec.-ft. when the river reaches a stage of 21 ft. on the Canal St. gage or 20 ft. at Carrollton, and with the crest of the dam fixed at an elevation of 16 ft. on the Canal St. gage or 15 ft. on the Carrollton gage.

The discharge through the spillway and the relief in flood height obtained at various stages is indicated in the statement below:

Carrollton Gage, Ft.	Canal St. Gage, Ft.	Discharge through the Spillway Cu.Ft. per Sec.	Velocity Ft. per Sec.	Relief in Flood Height at N. O. Ft.
15	16	0	0	0
16	17	30,000	5.0	0.5
17	18	65,000	5.4	0.9
18	19	115,000	6.4	1.9
19	20	180,000	7.5	3.0
20	21	250,000	8.3	4.2

It is estimated that such a flood protection measure can be completed at cost of between $4,000,000 to $5,000,000 including the purchase of land for right of way, construction of side levees, river bank protection work at the location of the spillway, concrete spillway, protective aprons and creosoted timber bridge for existing railroad and highway communication.

Recommendation—The committee does not advocate the construction of the spillway in lieu of undertaking the raising of the levee line to the Mississippi River Commission grade. Its recommendation is that the spillway should supplement the proposed levee construction as an additional factor of safety not sufficiently provided for by levees built to existing standard grades. It knows of no instance in this country or in Europe where the superelevation of the crest of a dam above past high water heights is as little as in the case of Mississippi River Levees. In the absence of any topographical area near this city sufficiently elevated that might serve as a refuge for the thousands of persons who would be driven from their homes in the event of an overflow, the protection of this city against inundation by the flood waters of the Mississippi River is the paramount necessity facing this community. Conservatism in this regard cannot be excessive.

Why the Spillway Will Not Solve The Mississippi Problem

By C. McD. Townsend

Colonel, Corps of Engineers, U. S. A. (retired); formerly President, Mississippi River Commission, Brooklyn, N. Y.

AFTER the flood of 1912, I submitted to the Mississippi River Commission a paper on various methods of controlling floods (published in Vol. VII of the Memoirs of the Corps of Engineers, U. S. Army) in which I express the following opinion:

In applying these principles to spillways in the vicinity of New Orleans, it is to be noticed that the conditions governing the flow of water through a spillway differ materially from those through a crevasse or outlet. When a crevasse occurs there is a violent change in the regimen of the river. The flow through the crevasse at first suddenly accelerates velocities above it and retards them below.

A sudden increase in velocity is conducive to scour, and the formation of sand waves. The retardation of velocities below the crevasse tends to cause a deposit both of the sand waves and of the material intermittently in suspension. But, due to the frictional resistance of the river bed, this scour and fill is confined to a comparatively short distance, and as soon as the reservoir capacity of the river adjusts itself to the new conditions abnormal velocities both above and below the crevasse cease.

As soon as the flood subsides to a bank full stage, there is a tendency for the river to return to its normal form filling the channel scoured above the crevasse and removing the deposits below.

When the river rises above the crest of the spillway, no sudden change will occur either in the reservoir capacity, slope, or velocity. Above it the slope and velocity will gradually increase; below, they will also increase, but the increment will be less, and, due to the proximity of New Orleans to the Gulf, and absence of any tributaries to the river below that city, the changes in these increments will not be as great as are liable to occur at localities further up the river from the sudden inflow from tributaries, particularly at the mouth of the White and Arkansas Rivers.

A spillway also differs from an outlet in that the outlet is discharging at all stages, and diminishes the flow at low water, when the crossings are being scoured, and all the water that can be utilized should be employed to increase such action. The spillway abstracts water from the river only at high stages when the crossings are filling. It will affect the amount of oscillation of the bars more than the ultimate depth of the crossings at low water.

These views were accepted by the majority of the Mississippi River Commission, which since 1912 has practically endorsed spillways properly located, as a means of reducing flood heights. In fact two spillways have been maintained, one at the head of the Tensas Basin and the other at the mouth of the Red River, both of which discharged during flood stages about 300,000 sec.-ft.

The spillway at the head of the Tensas Basin was the result of dire necessity. Its flow flooded a large area in the back parishes of the basin, but it was recognized that the levees in front of the Tensas Basin and those opposite in the lower portions of the Yazoo Basin were not sufficiently strong to resist the increased flood heights that its closure would produce. Therefore, the levee districts affected were given six years to enlarge their levees, and then at the earnest request of the engineers of the State of Louisiana, the commission authorized its closure.

The increased heights attained by the flood of 1922 in Louisiana over that of 1912, were the logical results of this authorization. However, the action of the commission in permitting the closure has been vindicated, since the levees of the Yazoo district have withstood the strain and the damage caused to planters by the discharge through the crevasses in Louisiana was small when compared to that which had been caused by the discharge through the spillway.

There have also been repeated requests to close the spillway at the mouth of the Red River, which the commission thus far has refused to authorize. The discharge from this spillway flows down the Atchafalaya River and the damage it causes to planters along that river can readily be controlled by extending its levee system. This locality furnishes an ideal location for a spillway. It materially lowers flood heights along the levees below it and its discharge causes a minimum damage to the country through which it flows. Annual dredging, however, is required to maintain a navigable channel during low stages between the Red River and the Mississippi. If this dredging were discontinued the discharge capacity of the spillway would rapidly diminish. For this reason it should be classed as a spillway instead of an outlet.

Herein I have confined myself to an examination of the project for a spillway near Lake Borgne.

Problem of Spillway—The problem of the spillway is not what will happen to the water and sediment which remain in the river, but what the discharge of the spillway and the sediment which it contains will do. The greater part of the report of the committee, therefore, has nothing to do with the case. The most ardent supporter of the levee theory will admit that when channel depths over bars exceed 60 ft. at low water, as is the case at New Orleans, the question whether levees improve navigation is purely academic, and of no practical importance. The problem of navigation by ocean vessels is confined to the river's mouth. The committee also ignores the question what a discharge of 250,000 sec.-ft. will do while passing through the spillway.

Humphreys and Abbot state that there is a difference of level of 8 ft. in a distance of 3,000 ft. from the river bank and that thence to Lake Borgne there exists a marsh which is practically at Gulf level. On a slope of 8 ft. in 3,000 heavy rainstorms will gradually create incipient gulleys even in glacial drift, as can be seen by examining any field in the northern states where such a slope can be found. The alluvium which forms the banks of the Mississippi River below New Orleans is much more subject to erosion.

While the slope at small discharge may closely conform to that of the ground, a discharge of 250,000 sec.-ft. will attain Gulf level in Lake Borgne and have an elevation of over 20 ft. at the river bank, or an average slope of 4 ft. to the mile. Such a slope can only be maintained when a river flows over a bed of rock and some conception of the force so generated can be obtained by gazing on the lower rapids of the Niagara River.

When a volume of water represented by a discharge of 250,000 sec.-ft. over a weir moves on a slope of 4 ft. per mile over the alluvium of lower Louisiana, it does not require the expenditure of $200,000 for a model river in a laboratory in Washington to foretell what will happen. Every river that flows through lower Louisiana is a better model than can be created from the soils of Washington, and nature has provided a perfect one in front of the city of New Orleans without cost, since the low water discharge of the Mississippi River at that locality is about 250,000 sec.-ft. This model teaches that when a flow of 250,000 sec.-ft. in Louisiana alluvium has adjusted its bed to its discharge, it has a slope of less than 0.1 ft. per mile, and an area of cross-section exceeding 150,000 sq.ft., a depth varying from 60 ft. to 140 ft., a width varying from 1,800 ft. to 2,300 ft., and a mean velocity of about 1.5 ft. per second.

In the distance of five miles from the river to Lake Borgne, it will be impossible for a river to adjust the bed to the discharge, but it will strive to make such an adjustment. The flow down the Atchafalaya River has not yet attained an equilibrium, yet channel depths of 80 ft. exist when the discharge is 250,000 sec.-ft. There is, however, little probability of this channel extending to the Red River spillway for many years on account of the large lake which is created at the lower end of the Tensas basin by the overflow.

Dangers from Spillway—It is noted that the plans of the committee provide for a creosoted timber bridge for existing railroad and highway communication, which is presumably to be located between the river and Lake Borgne. The piers of such a bridge will form a considerable obstruction to the flow of water and scour around them will result. Before a discharge of 250,000 sec.-ft. is attained, a section of the bridge will be found placidly floating on the water of Lake Borgne, and a channel similar to that which now exists in the Poydras crevasse will be in process of creation at the site of the bridge. The least dangerous solution of the bridge problem across the spillway would be a concrete structure on the weir itself, but even in such a location the piers would create irregularities of flow which would induce scour. The piers of the Eads bridge at St. Louis score the alluvium to bedrock, during floods in the Mississippi. The diameter of the particles of sand, which form the river bed at this locality, largely exceeds that of those found in Louisiana soils.

But even if it is assumed that the bridge is not constructed, when the spillway begins to discharge, irregularities of flow would be created by the protective apron of the weir, by a half sunken log or even by an abandoned fence post. Such variations of flow would start a small scour which will rapidly enlarge as the discharge increases.

A crevasse discharging 250,000 sec.-ft. rarely occurs in lower Louisiana without a hole being scoured somewhere in its path to depths of 50 or 100 ft., and if the flood is prolonged there is a decided tendency for this hole to develop into a channel at right angles to the river bank. Such action moreover takes place when the surface slope does not exceed one foot to the mile, as in the crevasses which have occurred near Lake Providence. In a crevasse the causes which produce the hole are unknown, but in a spillway the protective apron to the weir would create a scour, and if by any chance the unknown causes which create a hole 100 ft. deep in a crevasse should begin operations in the scour started by the apron, serious consequences would result.

The settlement of levees described in the report of the committee does not usually result from a movement of the surface soil, but from the squeezing out of a layer of clay of a muddy consistency from 10 to 20 ft. below the levee. Such a settlement is usually accompanied by a raising of the surface of the ground in the vicinity. In constructing a levee across the lower end of Lake Providence, the settlement created a banquette 12 ft. high, lifting up with it cottonwood trees 2 ft. in diameter. When the Lake Beulah crevasse was closed the ground rose behind the levee to an elevation higher than the banquette.

I have no knowledge of the nature of the subsoil in the vicinity of Lake Borgne. There is, however, a possibility that the marsh which exists around the borders of the lake originally extended to the Mississippi River, and that the banks of the river have attained their existing heights from sediment deposited during overflows. Under such conditions the soil would be of a character similar to that described by the committee and the erosion of the surface soil would expose a soft strata to a pressure both from the weir and from the river, without an opportunity for an equilibrium to be established by an elevation of the land surface.

A concrete weir 8 ft. high will exert a pressure on its foundation equal to that of a high levee, since concrete weighs considerably more per cubic foot than earth, and the weight is concentrated on a narrower base. In this connection attention is invited to the statement of the committee which is considered of such importance that it is printed in double-sized capitals, that "foundation defects are disclosed only at extreme stages when it is not practicable to correct them." If foundation defects should occur under the weir when it was discharging 250,000 sec.-ft. and the flood stage was 21 ft., it is pertinent to inquire what would happen to it.

I do not pretend to solve such a problem, but I do predict that if a portion of the weir should happen to slide into the hole that had been excavated, a Poydras crevasse would also exist at the site of the weir, and that the only thing that would prevent the Mississippi River from creating a new outlet would be the narrow marsh between the weir and Lake Borgne over which a flow exceeding 400,000 sec.-ft. would be concentrated by the levees of the spillway. Whether the Poydras channel would be excavated to Lake Borgne would depend on the duration of the flood after the break in the

weir occurred. There is a possibility that the weir may stand but the chances favor its destruction.

A weir of the cross-section adopted by the committee for computing the discharge is a hazardous experiment even before the water begins to flow over it. It has a width of base about ten times its height, and a smaller factor of safety against percolation than the levee section adopted by the Mississippi River Commission for firm soils. In the alluvium of lower Louisiana, dangerous sand boils are not infrequent during floods, where the path followed by the water is 20 times the head.

There is also a strong probability that even if the weir remained upright after discharging 250,000 sec-ft. for a month, such a scour would occur in the spillway that the people of New Orleans would become panic stricken. Neither an academic discussion of the influence of spillways nor an experiment with Washington soils then would satisfy them. They are too familiar with the treacherous character of Louisiana soil from building construction within the city.

How High Should Levees Be?—But while the arguments of the committee are considered irrelevant in discussing a spillway at Lake Borgne, they have a bearing on the important question of the *elevation to which levees must be constructed to resist future floods* and therefore merit analysis.

The committee invites attention to a fact long known to river engineers that the amount of sediment carried by the river in suspension at New Orleans bears an obscure relation to flood heights, but they appear to be ignorant of the cause of the phenomenon. The explanation is simple. The Missouri River flowing through the bad lands of Montana, and the prairie soils of the western states is more saturated with sediment than the Ohio River which derives its discharge from a hilly country. In the one a large component of the sediment is a light clay, in the other a heavy sand. The stage curve submitted by the committee (Fig. 4) conforms to the discharge curve of the Ohio River and the turbidity curve to that of the Missouri River though both are modified by the inflow from other tributaries. When a river discharges either clay or sand, deposition takes place at any stage if the velocity is checked, but the amount deposited in a river transporting clay is greater than in one transporting sand.

They also emphasize another well-known fact, that the river discharge at a given stage constantly varies. A river's discharge is dependent not only on the area of its cross-section but also on its slope. Another important factor is the reservoir capacity of the river bed. These two factors have caused a variation of 30 ft. in the flood heights of the Ohio River at Cairo in discharges attaining a height of 50 ft. at Cincinnati. Humpreys and Abbot state that they have reduced a flood discharge at Cairo about 400,000 sec.-ft. when it arrived at Natchez.

When slope is ignored, the published discharges of the Mississippi River can be utilized to prove almost any proposition by a skillful selection of discharges. For example, on Fig. 1 of the committee's report the discharge of 1916 when compared with that of 1912 as conclusively proves that the river is enlarging its cross-section as that of 1922 proves that the bed is filling. The stage at Cairo exceeded 50 ft. twenty-two days during the flood of 1912, twelve days during the flood of 1916, and fifty-five days during the flood of 1922, a sufficient cause for gentler slopes on the lower river during 1922 than in preceding years, without taking into consideration the inflow from tributaries.

Levee Margins—The emphasized statement of the committee that "a margin of 1 ft. between the approved grade and a deduced water line of a past flood is not considered sufficient freeboard to afford protection against floods of the future" is true (the commission prescribes 3 ft.) but the means adopted to arrive at such a conclusion are open to criticism. The only statement that cannot be questioned is that the flood of 1922 attained a height on the Carrolton gage 3 in. above that of 1912. This is 0.9 ft. lower than the height the commission estimated floods would attain at New Orleans after the levee line was completed.

Any attempt to determine flood heights after the slope of the river has been disturbed by large crevasses is futile. The committee submits diagrams (Fig. 2) in which they appear to assume that the flood of 1922 would have culminated at New Orleans on May 16 instead of April 26 if no crevasses had occurred in the levee lines. If the gages on the upper river are examined it will be found that the flood culminated at Vicksburg, the lowest river gage unaffected by crevasses on April 18, and if no break had occurred in the levee line a hydrograph similar to that at Vicksburg would have been transmitted down the river to New Orleans, though modified to a certain extent by the discharge through the spillway at the mouth of Red River. The assumption that a crest of a flood is propagated in one day from the mouth of Red River to New Orleans, a distance of 192 miles, is approximately correct but it is absurd to assume that it required seventeen days for the same crest to move from Vicksburg to the mouth of Red River, a distance of only 170 miles. Something must have occurred in that stretch of river during the interval to seriously modify the river slopes. That something is the Concordia crevasse of April 26, which ultimately discharged over 600,000 sec.-ft. into the lower end of the Tensas Basin. The Atchafalaya River has a discharge capacity of about 400,000 sec.-ft., and the surplus water had to find an outlet either over the levees of Red River or through its mouth. The crests of the hydrographs of May 15 and 16 from Red River Landing to Donaldsonville have resulted from a secondary rise in the Mississippi having superimposed upon it the discharge from Red River. If the crevasse had not occurred, instead of water flowing from the Red River into the Mississippi when the second rise reached lower Louisiana, the Red River spillway would have been discharging about 300,000 sec.-ft.

Under such conditions the crest of the flood would have passed New Orleans by May 3 and its hydrograph published in Fig. 3 clearly indicates that the flood of 1922 if confined between levees would not have exceeded the crest of April 26 at New Orleans by more than 6 in., and would still be 3 in. below the height which the commission estimated that the confined flood of 1912 would have attained at that locality.

No two floods have the same slope and discharge, and in establishing a grade line, normal conditions during a great flood have to be employed. Local variations exceeding 1 ft., however, are to be expected. To provide a factor of safety for such variations and for errors in estimates, the commission has recommended the construction of levees to an elevation 3 ft. above the estimated heights of floods, which corresponds to the one

meter provided in European levees. Along the fronts of large cities a factor of safety which would result from constructing levees to a height 5 ft. above the flood line is warranted, but in a levee system 1,800 miles long, where local authorities are resorting to excessive taxation to establish the grade recommended by the commission, such a factor of safety would be an expensive luxury.

Lessons From Flood—The principal lesson to be derived from the flood of 1922 is the vital importance of maintaining the existing spillway at the mouth of the Red River. When the levee line is completed to commission grade, there is a possibility of floods at New Orleans attaining a height exceeding those estimated by the committee, if that spillway should be closed. It limits the discharge below it to about 1,500,000 sec.-ft., which, under normal conditions, would be reduced at New Orleans to 1,450,000 sec.-ft., by the reservoir capacity of the river.

New Orleans is not yet as safe from the floods of the Mississippi River as Boston, as was proclaimed by a league of business men prior to the flood of 1912, but there is less danger of a crevasse occurring at this locality than in any other part of Louisiana below Vicksburg, if the existing project of the Mississippi River Commission is completed.

What Cities Must Spend Annually for Their Water Supplies

REASONING from prewar figures of cost, compiled by the Bureau of the Census, corrected by present day indexes, the average city of 100,000 people must spend about $5,200,000 for new water-works construction during twenty-three years, the period in which it will double in population. Since there are about twenty million people in the 105 cities of more than 30,000 population in the census referred to, the average annual expenditures for these 105 cities is $45,000,000. Charles B. Burdick, consulting engineer, Chicago, gave the basis for these figures in a recent paper presented to the Iowa Section of the American Water Works Association. Further abstracts from his paper are as follows:

The latest available United States census statistics, which refer to prewar conditions, indicate that the average investment in municipal water-works is $32.60 per capita of the cities supplied. The average operating expense was $1.48 per capita. Allowing 6 per cent for interest on the investment, and 1 per cent for depreciation, the fixed charges would be $2.28, making the cost of water $3.76 per capita, including operation and fixed charges.

At the present time our works are operating upon a higher scale of prices, although somewhat lower than those obtaining two years ago. Cast-iron pipe, which is the largest item in water-works construction, was worth about $25 a ton at Chicago before the war; $85 at the peak early in 1920, and about $49 at the present time—100, 355, and 200 per cent respectively as compared with the prewar basis. Common labor, using 1915 as the 100 per cent basis, increased to about 225 per cent on the average, and has receded to a little under 200 per cent. Other items entering into the cost of water-works are, however, now upon a lower price basis, particularly construction costs, which were very high and uncertain two years ago. Recent appraisals of several plants in detail indicate a total price basis approximating 160 per cent as compared to 100 per cent prewar. Applying this ratio to the census figures indicates that at the present time new water works construction costs not less than $52 per capita.

The review of operating expenses presented by Leonard Metcalf in the September *Journal* of the American Water Works Association indicates that the per capita operating expenses probably approximate 175 per cent at this time as compared to a 100 per cent prewar base, and, therefore, probably approximate in the neighborhood of $2.60 per capita per annum. Seven per cent to cover interest and depreciation on $52 per capita investment is equivalent to $3.64, which added to the present operating expenses makes the cost of water about $6.24 per capita, or approximately 170 per cent of the prewar figure.

Water-Supply Permit Applications in New York State, 1905-22

By Russell Suter
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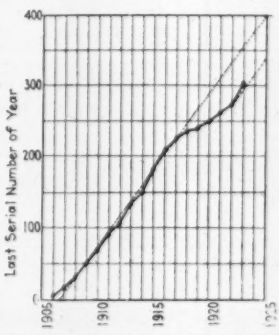
STATE approval prior to construction has been required in New York State for most new water-supply projects since 1905 and for all such projects since 1907. This jurisdiction has been exercised, successively, by the Water Supply, Conservation, Water Power and Water Control Commissions. Although not the best measure that could be devised, the number of such applications received within a year parallels somewhat the water-supply activity during that year and a plotting of these numbers from the beginning (see cut) seems to give a reasonably accurate picture of the effect of the war and of the present conditions in this particular field.



WATER-SUPPLY PROJECTS IN NEW YORK STATE

Serial number of final application of each year is plotted as a solid line. This gives an approximmately straight-line with an average of 21 applications a year up to the close of 1916. The dotted line indicates that the applications for the six years ending with 1922 had fallen behind the equivalent of three years normal progress.

Somewhat remarkable general uniformity existed during the normal period from Jan. 1, 1908, to Dec. 31, 1916, showing a yearly average of about 22 applications. Slacking up due to the war is most marked, reaching its maximum at the end of 1921, when the actual progress was 60 applications short of the average.

Demand for the construction of these delayed projects, intensified by the dry weather of 1920 and coupled with marked decline in interest rates, construction and material costs, caused increased activity during 1922, but this was curtailed early in the season by the abrupt increase in the price of cast-iron pipe, lesser increases in other costs and difficulties in getting deliveries of material.

Future progress probably depends more on the price of pipe than on any other one factor. Even greater demand exists than is shown by the curve, as many projects approved since 1916 have not yet been constructed. Whether the ground lost will be recovered seems doubtful and perhaps when conditions become stabilized a lesser rate or progress will prevail.

At present water-supply permits in New York State are granted by the Water Control Commission, composed of the conservation commissioner, attorney general and state engineer.

Irrigation Opportunities and Duties of Federal Government in Western Land Reclamation

May Reclaim 20,000,000 Acres More, or Ten Times Present Accomplishment—Human Problem Dominant—Further Development Rests on Government Action

By F. H. Newell
Chief Engineer 1902-1907, then Director to 1914, now
Consulting Engineer, U. S. Reclamation Service

THE public domain, which rightly may be considered as the heritage of all the people, is held in trust by the Federal Government. Until the government disposes of this estate its duty and responsibility in administration must continue. By far the largest part of this property is in the West where are 180,000,000 acres of vacant public land. Here for many years to come the opportunities and corresponding duties of the government will be greatest. Up to a comparatively recent date the attitude of Congress has been that the development of these resources was the proper subject of private initiative. Under this policy, vast areas were donated to individuals, to corporations, or to states for various objects. Some of the states promptly disposed of these lands. Thus enormous tracts were acquired under different laws, or passed to individuals by reason of evasion of law and laxity in administration.

During the quarter of a century preceding the enactment of the Reclamation Law, Congress was importuned to undertake the development of the public domain, but aside from investigations, surveys, and withdrawals of some reservoir sites, no definite step in this direction was undertaken until 1902. Meanwhile, the West had gone through several periods of exploitation in connection with state and private enterprises, the majority of which left the promoters bankrupt and disillusioned. These undertakings absorbed most of the attractive opportunities for development. Upon the entrance of the government in the field, its engineers were compelled to take up projects which, by reason of natural obstacles, interstate and legal complications, and relatively high costs had been passed over by others.

Success of Government Reclamation—The success which has followed the completion of the government reclamation works is due to causes readily understood. The investment bears no interest, and the settler acquires at cost the water for his land. In the case of private enterprise the accumulation of interest and overhead during the period of construction and of settlement of the land frequently equalled the construction costs, with resulting bankruptcy for the promoters, whose works, however, were not necessarily failures except financially. Liquidation enables the farmers to acquire the property at low valuation; in many instances prosperous and permanent communities have been established which are aiding in building up the state. The national projects, burdened with no interest and seeking no profit, could wait for the coming of the settler, and when necessary could defer repayment of the annual installments on cost until the crop production enabled the farmer to make these.

It has never been the policy of the government to interpose obstacles in the way of private capital seeking to promote irrigation. On the contrary, it has done everything possible to aid by topographic surveys and water measurements, grants to states under the Carey Act and other ways. Many attempts were made by exploiters to hold up construction by filing on reservoir or dam sites, by claiming water rights and by other methods; and in many instances the government, temporarily at least, withdrew from the field.

May Reclaim 20,000,000 Acres More—Inasmuch as most of the remaining cultivable lands of the West are arid and can be developed only by the construction of works of even greater magnitude than those already built, and as private enterprise can see no legitimate reward for the risk, it is obvious that future development of these areas can be brought about, if at all, only through government agencies. Possibly 20,000,000 acres more can be reclaimed—furnishing homes for a half million families.

The problems of national reclamation are varied, numerous, and often complex. The types of many of the larger structures were quite new; they called for a venture into the unknown. Inaccessibility of location, the necessity of highways in mountainous regions, erratic character of the streams, management of construction camps remote from food and material supplies, building of railways, telephones, power plants, and a thousand and one other needs, have taxed the ingenuity of the builders and have developed initiative and efficiency not called for on works of this nature in the midst of established communities.

Human Problem the Greatest—The greatest problem of reclamation, and its most important one, is not wholly solved. It is the human problem. From the outset this was so recognized, and efforts have been made continuously to devise methods of solution. The problems have become more complex by reason of omission in the organic law creating the Reclamation Service. This did not provide authority for selecting the farmers who should acquire the land after reclamation. In every instance after the lands were opened to reclamation, the incoming tide of homeseekers carried a considerable percentage of those who lacked capital or experience adequate for the hard task of pioneering. The right to file on the land could not be denied to the citizen. The main qualifications were that he had not previously used his right, and did not own 160 acres of land somewhere else. While it is a matter of gratification that under these circumstances the failures were so few, yet it can not be questioned that the entry of so many of those who were unfit brought needless suffering and privation and has retarded the orderly progress of land development.

Apparently no useful purpose has been served by the Government in issuing to the homeseekers the warnings as to the requirements of physical strength, experience, and capital, necessary to meet the vicissitudes of life in a new country. The proportion of those unqualified

for such life, who appear at every opening of new projects, has not fallen off thereby.

Since the inflation due to the war's aftermath, the need for a new phase of engineering has arisen, in order that a more definite understanding of the human equation on the projects may be obtained. This work takes the form of an economic survey, which has just been undertaken by Secretary Fall, and which it is hoped will disclose certain facts and factors now unknown, or at least not well understood.

The Present Dilemma—The plan of the national reclamation, unique in that it provides for the return of the investment of federal funds by the beneficiaries, is little appreciated by the public. The government occupies the position of creditor; the farmers are debtors. In times of prosperity the collections are easily made, but in times of distress, like the present, a different story is told. To a certain extent the debtors are justified in assuming that their creditor—the government—will not oppress them. Which horn of the dilemma shall the government take? If, in answer to the plea of some of the debtors for a general postponement of charges during the next few years, it brings about a cessation of present works and a postponement of future undertakings, what will be the fate of the present engineering organization, built up by many years of earnest and efficient work? What of the thousands of settlers who have been waiting on the desert for the waters necessary to make their lands productive? On the other hand, if the government insists upon the collection in its entirety of the just debt, and by so doing forces its debtors into bankruptcy, what then?

Fortunately, the situation is not as serious as might be inferred. On a few of the projects conditions are known to be bad financially. Partly at least, this is blamable upon the easy credit offered to the farmers; but mostly it may be attributed to the same causes which are affecting our agriculture elsewhere. Bad crops are not one of the causes. The 1922 harvest is perhaps the largest known, but with corresponding low values. With prices below production costs, with markets shot to pieces, or with transportation facilities wholly inadequate, the plight of the farmers on some of the projects is deplorable, but not worse than that of farmers elsewhere.

The Larger and More Far-Looking View—The arguments for additional government construction or activity in reclaiming the waste lands of the West, or of any part of the country, whether in public or private ownership, must be based primarily, *not* on immediate financial gains, but on the larger and more compelling needs of the country for opportunities for more homes, for creating these homes wherever they may be well located, especially in the less densely settled parts of the country. Such reclaimed places serve primarily as homes of citizens, and, secondarily, as rallying points for innumerable industries; they form the base upon which may be erected the fabric of the commonwealth.

The great need of the United States for the present is not for more wealth, but for more self-sustaining small farm homes from which comes the manhood of the nation. President Harding, in his first address to Congress on Dec. 6, 1921, states: "The base of the pyramid of civilization which rests upon the soil is shrinking through the drift of the population from farm to city. For a generation we have been expressing more or less concern about this tendency. Economists have warned and statesmen have deplored." While it will be difficult to produce any notable change in this direction so far as the East is concerned it is practicable to take advantage of the attraction which the West offers, and to create there, with less opposition, conditions which will add to our rural life and which will build up a rural population in accordance with the ideals of many statesmen.

To repeat: It is not the money-making side which should be emphasized in this connection but the higher, more far-reaching needs of the commonwealth, which should be met by making available on these waste lands the opportunities which have been enjoyed up to the present generation by the homeseekers who could go West and take up fertile government lands. Such opportunities as those following the Civil War no longer exist because the good prairie plow-lands have been taken up but similar chances may be created through the vision and skill of the engineer, who, carrying out the thought contained in his designation—that is, "the man of ingenuity" can remove the obstacles which nature has interposed, and can make many of these waste places suitable for human occupation.

A Corps of Skilled Engineers Developed—The government has already developed this skilled body of engineers who, through the expenditure of over $130,000,000, have constructed works which are already furnishing water to nearly 2,000,000 acres, of which 1,200,000 acres were cropped in 1922, with a gross production of $50,000,000 for that year, and of $475,000,000 in the years 1906 to 1921. The acreage return of these crops exceeds the average of the farm lands of most of the states of the Union. In spite of low prices and difficulties of transportation the farmers of these government projects are better off as a whole than their brethren elsewhere. Enough has been done under government direction to demonstrate that work of this kind is being and can be carried on with economy and efficiency.

All notable progress in the development of the West, whether of public or private lands, now practically rests upon governmental action. Experience has shown that the individual states cannot or will not undertake this work. One reason is that many of the projects are interstate, or involve legal questions which cannot be readily solved. But more important is the fact that the western states are relatively poor; they do not have the necessary funds for the work; nor have they been able to develop a continuity of purpose of engineering organizations such that the people have sufficient confidence to tax themselves to undertake great projects within the state. All are appealing to the national government to utilize its resources in money and men made capable by years of experience in successfully handling these large problems, not solely for money-making but for the higher ends for which the government exists, for stabilizing the government and its institutions and for the better insuring of "life, liberty and the pursuit of happiness."

Southern Pacific Adopts 110-Lb. Rails

In adopting the 110-lb. rail section of the American Railway Engineering Association the Southern Pacific Ry. is said to be the first road west of the Mississippi River to adopt a rail of such weight as its standard. The railway has ordered 50,000 tons of rails of this section from the Tennessee Coal, Iron & Railroad Co.

Traffic—A Major Engineering Problem

Two Articles on the Growing Demand on the Engineer to Solve the Difficulties of Travel on Both City Street and Country Road

City Traffic Regulation

BY E. P. GOODRICH
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STREET traffic regulation in the United States practically started with the placing of policemen on Broadway, New York City, about twenty years ago largely to protect pedestrians against the near-criminal action of the truckmen who used the roadway. Besides reducing profanity and protecting pedestrians against accident it was soon discovered that traffic was materially expedited, vehicle accidents reduced and money saved to vehicle owners thereby.

At first there was opposition to the extension of the police power when directed explicitly toward newly discovered benefits but in the course of several years the public saw the benefits elsewhere secured through traffic regulation and no protest was made or has since been registered. Thus the regulation of traffic under the police power has grown from the idea of crime prevention so as to include accident prevention and the expediting of travel. The introduction of these two ideas carried traffic regulation into fields distinctly within the province of the engineer.

Early Manual Control—At first regulation was purely manual on the part of the police officer. Even in some of the larger cities the manual method is exclusively used today; Cincinnati may be cited as an example. Inventive ability soon saw the ease of applying mechanical signaling devices to the problem and scores, if not hundreds, of patents have been granted in increasing numbers for traffic-control devices. Naturally, the earlier devices were somewhat crude. In one city large beach umbrellas were supported in light standards and had the words "Stop" and "Go" painted at the proper points on the canvas. The traffic officer stood beneath the umbrella and turned it through angles of 90 deg. by a handle attached to the stick. Sometimes he had to step out from under his protection in order to see which way his signs were pointing.

Much experimentation has been made by various cities with different devices, a traffic survey of Cleveland disclosing four different types along Euclid Ave. With the lapse of time devices have been becoming more and more complicated, primarily with the objective of extending the zone of control. The Fifth Ave. tower type is well known and has been adopted in such other cities as Detroit and Atlanta. In Atlanta additional lights suspended over the street intersections have been installed for several blocks in each direction along the streets which meet at the central tower. All the distant lights are operated simultaneously from the tower. Throughout the central business district in Los Angeles a system of combined semaphores and lights has been installed upon special posts directed at each curb corner. These are operated from a central station so that traffic is controlled throughout a considerable area.

The manual system has the advantage over mechanical systems thus far put into operation that traffic can be controlled so that it is almost continuously moving in all directions at all times, whereas the mechanical system introduces alternate stopping and starting at frequent intervals. In Springfield, Mass., the traffic officers control manually as many as 750 vehicles per hour at congested intersections more satisfactorily than is the case in some other communities where the mechanical system is used with much less traffic.

Field for Improvements—Considerable improvements still seem possible in perfecting the mechanical systems. These will call for expert engineering knowledge on the part of structural engineers, mechanical engineers, electrical engineers and illuminating engineers. In addition to securing mechanical, electrical, structural and luminary improvements it is believed that the most fertile field of possible betterment lies in a radical change of the method of control. Instead of using the "stop-and-start" or "block" system it has been shown to be entirely possible to effect regulation by what may be designated a "platoon" system. Under the latter scheme traffic would move in platoons or companies from end to end of a thoroughfare in each direction, such movement being controlled by a system of semaphores operated from a central station practically on the principle of the well known railroad block signaling system. Cross traffic at principal intersections can be handled in the same manner and so interlocked with that on the first mentioned street that vehicles once joining a company need never stop while moving in any given direction along any thoroughfare except under emergency conditions, such as fires, traffic accidents or similar contingencies in connection with which the traffic officer could intervene as occasion demanded.

Reducing Traffic Accidents—In the field of accident prevention there is opportunity for engineering ability in several directions. Automotive engineers can still further improve the accelerating power and the efficiency of vehicle brakes so as both to expedite travel and diminish accident. The investigations in Cleveland made with reference to the proportional number of accidents during daylight and night hours has conclusively demonstrating that the illuminating engineer has a great opportunity to improve street lighting fixtures and efficiency, especially at congested points and bad intersections so that accidents will be materially reduced.

The advent of the "silent policeman," especially of the flashing light type, has helped in this direction. Large mirrors, redlighted "mushrooms," unlighted red glass reflectors, and other schemes are being successfully introduced and the possibilities of improvement seem almost limitless. Co-operating with the illuminating engineer in the improvement of such devices as those above mentioned the highway engineer has enlarged the radius at curb intersections, improved sewer inlet designs, bettered the tractive efficiency of pavements without sacrificing pavement smoothness, improved grades and cross sections at difficult side hill and other intersections and otherwise contributed to easing traffic movement.

Traffic Economics—The subject of economics is coming more and more to the front in highway and pavement design and has been found to be one of the important elements in traffic regulation. The creation of "one-way" streets, the segregation of different kinds of traffic on parallel thoroughfares, the detouring of through traffic to avoid delays at congested points are all based primarily upon economic motives. Their study and further analysis is eminently an engineering problem. Traffic tallies, estimates of time lost through delays and a comparison of the enhancement in value of real estate, all compared with estimated costs of construction, showed that the introduction of a diagonal street in Newark, N. J. would pay for itself within a period of five years. A proposed cut-off street in Philadelphia would save certain through travel a distance of seven miles. The City of Worcester, Mass., was estimated to be losing $6,300 per day through delays, due to traffic congestion, which would largely be reduced by the creation of a diagonal thoroughfare, the estimated cost of which, including the taking of real estate, would be much less than the capitalized value of the daily community loss.

Whether to widen a main downtown congested thoroughfare by the setting back of expensive building fronts, by the arcading of sidewalks within the first floors of buildings or the relieving of the congestion by the creation of parallel thoroughfares through the less valuable centers of blocks is an economic problem constantly confronting city planning engineers—and one which should be answered along the lines indicated only after exhausting the possibilities of effecting congestion relief by increased stringency of traffic control, if the best economics of the problem are to be considered.

Highway Traffic Engineering

By Howard H. Parsons
Traffic Engineer for Erie County, N. Y.

PRODUCTION of motor vehicles, increasing from over a million cars in 1916 to two and one-half million in 1922, has resulted in a correspondingly large number of accidents on highways to persons and property. Law enforcement alone will not decrease the number of accidents, nor the damage done. The problem requires, first, adequate traffic planning, and, second, proper enforcement and regulation according to the plan as advised.

Traffic engineering is simply the application of those fundamental principles of engineering to traffic which bring organization and efficient movement out of disorder. Traffic engineering, by a study of each specific problem, reduces accidents and damages, and tends to result in an even flow of traffic on roads designed especially to meet the required tonnage. Careful investigation of traffic in the past has shown that 75 per cent of general accidents is due to causes which invite accidents, and that 90 per cent of the damage done to highways is through overloading of trucks on highways not constructed heavily enough to carry such traffic. By taking a traffic census on the various roads and by careful computations will be found the cost per ton mile. In the future, types of roads can be selected to carry best the kind of traffic permitted. The selection of the type and the width of any given new highway to be built should be based upon trained observations of traffic with reference to the number of cars and the tonnage. Where it is seen that the traffic is too congested and the road can be widened and improved, then the traffic engineer's recommendations are of great value. Should there be a parallel road, the traffic can be segregated by proper notice and routing. This, too, is a problem for the traffic engineer.

Highways should be properly sign-posted. The carelessness of the general motorist lies in not expecting or looking for obstructions, stub ends of roads, bad turns, steep grades, intersecting roads, railway crossings, etc. If all of these are properly and adequately posted, the element of accident is lessened.

The promiscuous lighting of highways by town and village boards should also be regulated. The height of lights above the road, as well as the character and power of lights should be uniform. As it is now, the lights are being placed too low and at points where, due to the shadows cast, driving is hindered instead of benefited.

Another subject is the regulation of speed. Our state law limits the rate of speed in incorporated villages to 15 miles per hour, and on all other highways outside of villages to 30 miles per hour. If traffic is to be expedited, more intelligent speed regulations must be devised.

Law enforcement alone cannot regulate all of the traffic evils. There must be whole-hearted co-operation by all highway users. In 1921, there was approximately 2,000,000 traffic accidents, with about 43 per cent of the accidents occurring at night, so one readily sees that 24-hours-a-day traffic protection and regulation is necessary.

The Traffic Census—On Nov. 21, 1922, a 24-hour-day traffic census was taken in the Village of Lenmore, N. Y. During the 24 hours, a total of 5,989 vehicles passed the checking point. Of these, 1,225 were trucks, or about 21 per cent of the total vehicular traffic, and only 2 per cent horse-drawn traffic. The total tonnage of vehicles, computed by taking the average weights of the different classes, was found to be 8,600, or approximately 3,000,000 tons per year. Then, a computation of the cost per 100-ton-miles, based upon the original cost of the road as 5 per cent bonds carried over a period of 20 years and the average yearly cost of maintenance, gives a cost of 16.2 cents per 100 ton-miles. Traffic censuses such as this taken on the several different through-routes will eventually show what the correct type of construction and the proper width of a new highway must be, as well as the amount of money which it is justifiable to spend.

The life of a $2,000 car is about 100,000 miles, or 2c. per mile, on good roads; 80,000 miles, or 2.5c. per mile, on fair roads; and 3c. per mile on poor roads. Then, taking 2 to 3c. as a vehicle mile expenditure, 2,000 vehicles per day would justify an annual expenditure of from $15,000 to $20,000 per mile. However, the true estimate of the expenditure can be more accurately computed on the traffic census basis where the tonnage is considered.

The above are just a few of the various branches of the main subject of traffic engineering, and as the advancing motor traffic brings out new industries and new ideas in transportation,, so will traffic engineering bring into play its usefulness to assist in the overcoming of the difficulties which will naturally arise with this certain advancement.

A Résumé of Criticisms of the Joint Committee Report

Abstract of the High Points in the Discussion of Concrete Specifications Being Prepared for Final Submission

The Progress Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete was presented to the constituent societies in June, 1921, in the form of a tentative specification for concrete and reinforced concrete. The structures covered in the specification included all types of buildings and retaining walls. Since the appearance of this Progress Report, considerable discussion has taken place in the societies represented on the Joint Committee, and among engineers and contractors generally. The nature of the discussion and the points most prominently considered reflect, to a considerable degree, those elements in reinforced-concrete construction which are receiving deepest consideration at the present time by thoughtful engineers acquainted with standard practice and the results of recent experimentation. It is the purpose of the present article, by an engineer who has had an opportunity to study most of the discussions, briefly to summarize the main issues under discussion developed through the issuance of the Progress Report of the Joint Committee.

PERHAPS no feature of the Joint Committee report received greater attention than the proposed clauses covering the proportioning of concrete mixtures. Three alternate methods of specifying the quality of concrete were offered, any one of which was to be selected at the discretion of the engineer who was making use of this specification. One of these methods proposes specification of concrete by the strength to be attained in a given period of time. A second method calls for predetermination of the strength of the concrete by tests of various mixtures of the materials to be used in the work, and based upon these tests, to specify the concrete for the work by the proportions shown by the preliminary test to be most satisfactory. The third method is the one now generally in use, in which the proportions of the ingredients entering into the concrete are arbitrarily fixed.

The discussion centering around the possible use of the first of these three methods, namely, the specification of concrete on the basis of resulting strength, irrespective of how this strength is acquired by the builder, has been both stormy and voluminous. It is contended by many that considerable improvement in the quality of concrete work can be obtained through exercising a more vigorous control over the proportioning and mixing of the concrete than at present obtains on average work. It is thought by many that such a clause in a specification would make it difficult for those contractors to obtain concrete work of consequence, who were not properly versed in the art, or who did not give proper thought and study toward obtaining satisfactory work.

It is pointed out by many engineers and contractors that the manner in which the concrete to be obtained is specified involves the respective duties of the engineer, on the one hand, and the builder, on the other, toward obtaining a desired quality of concrete in the finished structure. Some say it is the duty of the engineer to make tests from the materials which the contractor has to use on the work, and from these tests, to determine the proportions which he will put into the specifications by which the builder is to carry on his work. Others hold that the builder is undertaking to erect a structure, and that it is his responsibility, rather than that of the engineer, that the concrete which the builder puts into his structure be of a quality of a specified standard. It is agreed by many, holding either of these views, that there is room for considerable advancement in the study of the art, so far as proportioning and control are concerned, and that any clause which will require greater study and more careful performance of this phase of the work, is unquestionably a progressive step.

There is a feeling among some engineers and builders that the proposed clause to specify concrete by resulting strength, is logical and possible, and will ultimately be the prevailing form of specification, but that there still remains considerable study and experimentation, chiefly on the part of contractors, before this method can come into universal use without undue pressure on any of the parties to the work. In the meantime, it is obvious to these men that great interest has been aroused among engineers and builders, and a very great deal of study is now being given by builders and engineers to work out satisfactorily field methods and practical control features to obtain desired results with a fair certainty of ability to predetermine these results.

It is recognized that in many portions of the country the proportions usually considered to produce 2,000 lb. concrete in 28 days produces really 1,400 lb. or 1,500 lb. concrete. Ultimately the strength advances to 2,000 lb. or better. Consideration must therefore be given to the selection of the strength to be attained in the required time.

Test Requirements—It has been proposed that in the event the required strength of concrete is not obtained in the construction, further tests on the completed structure are to be made at proper intervals, and, if necessary, special means of curing resorted to, to bring the structure up to the desired strength.

Several schemes have been discussed for conducting field control tests during construction. The slump test is suggested for controlling moisture content or consistency. Cylinders made at the same time from concrete about to enter the forms, form the basis of strength control. It is suggested that half of these cylinders be stored alongside the point in the structure where sampling took place, and the remaining specimens be stored under laboratory conditions of temperature and moisture. Tests of these cylinders would be made periodically from both lots.

It is believed by many that the variation among cylinders of the same age and make-up is so great as to prevent a sufficiently accurate judgment of the average strength being obtained without a large number of specimens being tested. To make workable such a scheme of tests, it would necessitate, it is claimed, a tolerance or permissible variation below the required specified strength, within which some given percentage of the cylinders tested would be permitted to fall.

It is recognized that in many cases the duration of

the concreting operation is short, and hence the results of field tests would not, in some instances, be of use in further adjustment of the proportions. In such instances it would necessitate accurate knowledge on the part of the builder, prior to construction, of the materials from which his concrete is made.

Comparison With Building Codes—Another subject which has been given wide consideration is the cost of structures designed under the proposed design regulations of the Joint Committee specification, as compared with practice permitted by various city building codes.

Building codes, unfortunately, are not the direct result of test data, as interpreted by a committee having wide representation, but are the results of interpretations by as many groups as there are building codes. Furthermore, these codes are the result of work done at different times and hence based on varying amounts of available research data. The Joint Committee proposals, as to design, are based upon more recent data than are any of the building codes, and yet they too are arrived at independently without directly following any of the existing building codes.

The result of such procedure is that the Joint Committee's proposed specifications for design coincide in some instances with certain building codes, and in other cases, vary considerably therefrom in one direction or the other.

It has been pointed out repeatedly that the requirements of the Joint Committee would increase the cost of a reinforced-concrete building, of typical form, by something like 5 per cent over the cost of the same building constructed under the New York Building Code. In the one instance of columns alone, some critics have pointed out that the Joint Committee requirement increases the cost of the columns something like 30 per cent. Other engineers, from other parts of the country, call attention to the fact that this is perhaps not so important as it may seem because building codes of other cities can be shown to require a more expensive building than the Joint Committee requirement would produce. It is even pointed out that in some cases, the Joint Committee has been more liberal in column design than the building code for that particular city.

Thoughtful engineers see in this discussion a more important element than that of the commercial viewpoint. They realize that because one city permits a liberal design of column, and experience to date in that city does not disclose any failures traceable to this source, considerable weight should be given to the success of such liberality. On the other hand, they are not inclined to place entire reliance upon such seeming success when column safety factors are undetermined, and existing tests do not support such liberal design.

Waterproofing — The Joint Committee undertakes recommendation of waterproofing for concrete structures. Among the clauses on this phase of the work is a provision that integral compounds shall not be used. At the present time, integral waterproofing compounds are used by many engineers and builders. Few subjects in concrete construction are held in such variance of view as is the effectiveness of waterproofing by the integral method.

Some engineers inquire whether a distinction is made between inert admixtures to the concrete, and those compounds which are held to react with the lime in the cement to produce a water repellant coating of the particles or a sealing of the pores in the mass. Some engineers prefer to invest the equivalent amount of money that might thus be expended in additional cement, and still others hold that unless the waterproofing treatment will waterproof cracks subsequently formed in the structure, as well as the mass itself, there is little cause for its use. The discussion brings out the general admission that too few engineers understand waterproofing compounds and their effectiveness.

Expansion Joints—The Joint Committee recommends the placing of expansion joints in buildings every 200 ft., where the length exceeds twice the width. Many engineers call attention to a great number of buildings of much greater length performing satisfactory service without any expansion joints. Some engineers have the erroneous theory that additional reinforcement will resist the tendency of the concrete to expand or contract through temperature change. Many engineers suggest 300 ft., others 400 ft., as the proper maximum spacing of expansion joints in buildings. The lack of thorough evidence, and the variety of personal opinions point to the need for study of this important subject.

In summing up the discussion arising from the progress report of the Joint Committee, it is evident that interest has been aroused along lines of interpreting into practical building methods the results of experimentation. Out of it must come more extended knowledge of the uses of concrete, and, in general, considerable progress in the development of the art.

Status of the Government Concrete Ships

THE concrete ships built by the United States Shipping board during the war are not now in service, with the possible exception of one which has been sold to private parties. Two of the ships were lost at sea; the others are tied up at piers. The present status of the ships is given in the accompanying table from the Shipping Board.

CONCRETE VESSELS CONSTRUCTED FOR UNITED STATES SHIPPING BOARD EMERGENCY FLEET CORPORATION—NOV. 4, 1922

Name	D.W.T.	Type	Builder	Date of Delivery	Remarks
Atlantus	3,000	Cargo	Liberty S. B. Co. (Ga.)	11-11-19	Made 6 coastwise voyages. Now tied up at Claremont.
Cape Fear	3,078	Cargo	Liberty S. B. Co. (N. C.)	11-19-19	Made one voyage to West Indies and W. C. S. A. Sunk 10-29-20.
Cuyamacca	6,313	Tanker	Pacific Marine Constr. Co.	9-17-20	Made 7 voyages Gulf Mexican Trade. Now tied up Mobile.
Dinsmore	7,500	Tanker	A. Bentley & Sons	1-31-21	Never made a voyage. Now tied up Mobile.
Latham	7,500	Tanker	Fred T. Ley & Co.	5-18-20	Made 2 voyages in Gulf Mexican Trade. Now tied up Mobile.
Moffitt	7,500	Tanker	A. Bentley & Sons	3-15-21	Never made a voyage. Now tied up Mobile.
Palo Alta	6,171	Tanker	San Francisco S. B. Co.	9-18-20	Never made a voyage. Now tied up San Francisco.
Peralta	6,171	Tanker	San Francisco S. B. Co.	1-31-21	Never made a voyage. Now tied up Alameda.
Pulas	3,500	Cargo	Fougner C., S. B. Co.	10-23-19	Made 3 coastwise voyages. Grounded off Chilly Ledge, Me. Total loss.
San Pasquale	6,298	Tanker	Pacific Marine & Constr. Co.	10-18-20	Made 5 voyages Gulf & South-Pacific Mexican Trade. Now tied up New Orleans.
Sapona	3,000	Cargo	Liberty S. B. Co. (N. C.)	1-14-20	Made 5 coastwise voyages. Now tied up Claremont.
Selma	7,500	Tanker	Fred T. Ley & Co.	5- 6-20	Made one voyage Gulf Mexican Trade. Sold by Insurance Div. 3-14-22.

News of the Week

Program for Annual Meeting of Am. Soc. C. E. Announced

Engineering Education, Research and City Planning Will Be Chief Topics

The seventieth annual meeting of the American Society of Civil Engineers will be held in the Engineering Societies Building, New York City, Jan. 17-19. Discussions on the opening day will be devoted to engineering education. An excursion will occupy the second day. A series of talks on city planning will be heard on Jan. 19. Prior to the opening of the engineering discussions honorary memberships will be bestowed and the various society medals and prizes awarded.

On the morning of Jan. 17 the annual meeting will be called to order by the president of the society, John R. Freeman. Transaction of business and reports of committees will then follow. Honorary membership will be conferred on Leon Jean Chagnaud, Paris; Sir Maurice Fitzmaurice, London; Clemens Herschel, past-president of the American Society of Civil Engineers; John Frank Stevens, New York; and William Cawthorne Unwin, London. The following awards of medals and prizes will be made: The Norman medal to Charles H. Paul, for his paper on "Core Studies in the Hydraulic-Fill Dams of the Miami Conservancy District;" the J. James R. Croes medal to William Cain of Chapel Hill, N. C., for his paper on "The Circular Arch Under Normal Loads;" the Thomas Fitch Rowland prize to Gustav Lindenthal, consulting engineer, New York City, for his paper on "The Continuous Truss Bridge Over the Ohio River at Sciotoville, Ohio, of the Chesapeake & Ohio Northern Ry;" and the James Laurie prize to Arthur T. Safford and Edward P. Hamilton for their paper on "The American Mixed-Flow Turbine and Its Setting."

During the afternoon session in which special attention will be given engineering education, the society will have a joint meeting with the Society for the Promotion of Engineering Education. Charles F. Scott, president of the latter society; and William G. Raymond, dean of the College of Applied Science of the University of Iowa, will be the principal speakers. Discussions will follow. During the afternoon other phases of engineering education will be taken up by Magnus W. Alexander, consulting engineer of the General Electric Co., and managing director of the National Industrial Conference Board, and by John L. Harrington, consulting engineer of Kansas City and president of the American Society of Mechanical Engineers. On Thursday evening, Jan. 18, the smoker will be held, preceded by an address on "Transportation Keyed To Production," by Julius H. Barnes, president of the U. S. Chamber of Commerce.

Engineering research will be the subject of the meeting on Friday morning, Jan. 19. Arthur N. Talbot, past-president of the American Society of Civil Engineers; Alfred D. Flinn, director of the Engineering Foundation, and chairman of the division of engineering of the National Research Council; George K. Burgess, chief of the division of metallurgy of the U. S. Bureau of Standards; and Otto B. Blackwell of the American Telephone & Telegraph Co., will be the chief speakers. During the afternoon of Jan. 19 at the session on city planning Nelson P. Lewis, consulting engineer, New York City; Linn White, chief engineer of the Chicago South Park Commission; Morris Knowles, chairman of the Pittsburgh City Planning Commission and head of the engineering firm which bears his name; and George H. Norton, city engineer of Buffalo, N. Y., will present the chief discussions.

The president and honorary members' reception will be given the evening of Jan. 17 at Delmonico's. The reception will be followed by a dinner dance.

Through the courtesy of the Bethlehem Steel Co., Lehigh University, Rodgers and Hagerty, Inc., contractors, and of the Chamber of Commerce of Bethlehem, Pa., the society will make a visit to that city on Jan. 18, to inspect the Hill-to-Hill bridge and the Bethlehem Steel Co. plant.

Railroad Bridge Across Newark Bay Finally Authorized

Secretary of War Weeks, on Dec. 30, gave final approval of the plans of the Central Railroad of New Jersey for a bridge across the lower end of Newark Bay to replace the present trestle and drawbridge. This marks the end of a long and determined effort of the City of Newark to prevent the construction of the bridge permit for which was first given some years ago. The city contended that the bridge, in spite of a wide lift span across the channel, would form an obstruction to the marine traffic seeking the port of Newark, and an effort was made to force the railway either to tunnel the bay, at expense many times that of the bridge, or to divert its main line above the the city's main port. Secretary Weeks' approval letter says that the railroad plans provide, in the way of drawbridges, ample openings for navigation, particularly as the channel to Newark is otherwise far from perfect.

Presumably, work on the bridge will be started immediately. Its cost is estimated at $9,000,000.

More Power at St. Paul

Plans have been announced by the Northern State Power Co. in St. Paul, Minn., that that company is about to start a ten-year construction program involving the expenditure of $80,000,000 for steam electric and hydro-electric power in northern Minnesota. The first unit is a new steam plant on the banks of the Mississippi at St. Paul, to which it is intended to bring the coal by barges up the Mississippi. The second unit is a hydro plant on the St. Croix River near St. Paul and will not be built until next year.

Seven Indicted for Fraud in War Camp Contracts

Federal Grand Jury Charges 50 Overt Acts Against Former Members of Emergency Construction Committee

Seven former members of the Emergency Construction Committee of the Council of National Defense have been indicted by a federal grand jury in Washington charging defendants with fraud in connection with contracts for the erection of cantonments, port terminals, warehouses and fortifications during the war. Those indicted are:

Benedict H. Crowell, former Assistant Secretary of War and President of the construction firm of Crowell-Lundorff-Little Co.

William A. Starrett of New York, architect and engineer, member of the firm of Starrett & Van Vleck.

Clemens W. Lundorff of Cleveland, vice-president and general manager of the Crowell-Lundorff-Little Co.

Clair Foster, formerly associated with the George A. Fuller Co., New York City, and the Thompson-Starrett Co., New York City, and during the war a major in the Engineer Corps.

Morton C. Tuttle, general manager of the Aberthaw Construction Co., Boston.

James A. Mears, of Boston, formerly with Fred T. Ley & Co.

John H. McGibbons of Baltimore, representative of a bonding company.

The indictment, which is the first to result from alleged fraud growing out of the cost-plus system of contracts, does not detail various and specific acts of the defendants. However, defendants are charged with conspiring to defraud the government by unlawfully delaying and hindering the administration of the laws and policies and procuring, to be paid to contractors for building army cantonments, sums of money in excess of what was reasonably earned and due under the contracts.

The indictment further recites that the defendants "conceived the fraudulent scheme and plan of getting control, for their own gain, profit and benefit, and for the gain, profit and benefit of their past and future clients and employers and their friends, of the administration of the immense emergency construction program of the United States during the war, including the determination of the policy to be followed, the form of contract, grossly, unconscionably and fraudulently favorable to the contractors, and in a like manner and to the same extent unfavorable to the United States."

Belgium Present Stanford "U" With Hoover Statue

Through an official representative Belgium has dedicated at Stanford University, Palo Alto, Calif., a bronze statue in recognition of the services rendered to that country during the World War by Secretary Hoover, who is a graduate of the California institution.

Dust Explosion Damages C.P.R. Grain Elevator

The Canadian Pacific Railway's concrete grain elevator in West St. John, N. B., was badly damaged Dec. 20 by spontaneous combustion of grain dust. The explosion occurred on the bin floor which is situated at the top of the concrete walls. Above the concrete walls the sheathing was shattered. Some of the conveying tubes were also badly damaged but the machines did not appear to have suffered to any extent. Following the explosion fire broke out in three or four of the bins where thousands of bushels of grain were stored. This, however, was easily extinguished.

The elevator is of a 1,000,000-bu. capacity and was practically full at the time of the explosion.

Drainage Contractors Approve Standard Specifications

At the annual meeting of the Levee & Drainage Contractors Association, held in Chicago on Dec. 28, it was voted to appoint a committee to cooperate with a committee of the National Drainage Congress in a final revision of standard specifications for excavation work. This joint committee will select an attorney to pass upon the legal features of the specifications as already adopted by the Association. A special feature of these specifications is an arbitration clause which is expected to avoid much litigation over disputes arising during construction.

The address of the president, R. H. McWilliams, dealt with the proposed amendment of laws in Alabama and a constitutional amendment in Louisiana to facilitate drainage development and the marketing of securities of drainage districts. Another matter considered briefly was the securing of lower rates for contractors' second-hand equipment when shipped from one job to another. This question is being taken up with the Interstate Commerce Commission. Officers were re-elected as follows: President, R. H. McWilliams of the McWilliams Dredging Co., Memphis, Tenn.; secretary, C. S. Gannon, Arcade Building, St. Louis, Mo.

Cornell Engineers to Hold Annual Reunion

The seventeenth annual dinner and reunion of the Cornell Society of Engineers will be held at the Fifth Avenue restaurant, 200 Fifth Ave., New York, Jan. 19, 1923. All Cornell men are invited. President Livingston Farrand and Dean Dexter S. Kimball will speak. Carroll R. Harding, president of the society, will be toastmaster. Moving pictures from Ithaca will be shown.

Short Course for Texas Water and Filter Plant Operators

The fifth short course for Water and Filter Plant Operators in Texas will be held at Dallas, Jan. 15 to 20, 1923, under the auspices of the Dallas Health Department, with the Texas Board of Health and the Texas Water Works Association. The director of the school will be Dr. W. T. Davidson, director public health, Dallas, from whom particulars may be obtained.

George Sears Greene, Jr.

George Sears Greene, Jr., whose death was noted last week in these columns, was formerly a director, treasurer and vice-president of the American Society of Civil Engineers, and well known as a consulting engineer in New York City and as former chief-engineer of the Department of Docks. His father was one of the twelve organizers of the American Society of Civil Engineers, and served for many years as director and from 1876 to 1877 as its president. His son, Carleton Greene, is a present director of the society.

Mr. Greene was born in Lexington, Ky., in 1837. He entered Harvard University in 1856 but left before graduation to study civil engineering under his father. His early professional experience was gained on the Croton Aqueduct, where he was employed as assistant engineer, on various Cuban railroads, and in copper mines in the Lake Superior region.

In 1875 Mr. Greene became engineer-in-chief of the Department of Docks of New York City, a position which he held for twenty-two years. During that time he designed and built the bulkhead or sea wall which surrounds a large part of Manhattan Island. Mr. Greene also originated, designed and partly completed the Chelsea Improvement on the North River between Charles St. and 23rd St. This consisted of the excavation of a strip of filled-in land covered with factories and other buildings about 3,100 ft. long by 400 ft. wide, which now accommodates the 800-ft. piers occupied by steamship lines.

From 1911 to 1914 Mr. Greene was a member of the board of advisory engineers of the State Barge Canal, during which time the Scotia, Delta and Hinckley dams were constructed, as well as the Medina Aqueduct.

Mr. Greene also was an inventor, having invented the drifting head which is in use on all engineers' transits.

He was a member of various technical and social clubs in New York and an honorary member of the American Institute of Architects.

Defective Supporting Timber Causes Concrete Collapse

A curious accident occurred in the concrete building being built for James Butler at Nelson and School Sts., Long Island City, on Dec. 9. In this reinforced-concrete building the floors are carried on columns about 18 ft. center to center. Forms to carry the concrete second floor were supported by trusses resting on uprights footing on the first floor. One of these uprights came directly over a scale pit about 4 ft. 6 in. square, and to receive it an 8 x 8-in. timber had been placed across the pit. It turned out that this 8 x 8-in. timber was defective, containing a large knot and when the concrete for the floor form was being poured the 8 x 8 broke, dropped the upright and its supported truss, and consequently pulled down the forms and the fresh concrete floor for an area of about 60 ft. square.

Engineering Employment Steadily Increases; Salaries Rise

Engineering employment has been getting better every month during the past year, according to the employment department of the American Association of Engineers. Each month there was a smaller number of unemployed; and many made fairly lucrative connections. During December employment was comparatively dull due to the usual year-end pause.

For the next year, there is every indication that a big shortage of technical men will be experienced, especially during the first few months. Already the demand for designers on all classes of work is far below the supply, with a larger demand certain as new work is started.

Conditions in all sections of the country are fairly good. A slight pause in employment is noticed in the northwest and northern sections but when construction opens there will be plenty of employment. The southwest and southern sections are booming with practically no unemployment. In the central states the demand has already exceeded the supply. Conditions in the East are fair. There is probably a larger number of unemployed in the East at this time than elsewhere.

The following table shows the trend of employment:

	Nov. 1922	Oct. 1922	Nov. 1921
Applications for employment	1,379	1,232	1,661
Positions received	336	425	335
Men referred	977	1,277	1,639
Men placed	130	161	193

Salaries for the past year have been on a gradual increase in the more basic positions. Where an electrical engineer was receiving $200 at the beginning of the year, the same position is now paying about $220. Where a structural engineer was receiving $225 at the beginning of the year, the same position is carrying a salary near $250. Most of the salaries that were decreased are in the county and municipal fields, occasionally on industrial and manufacturing work, and some railroad positions.

The average salary for graduates was considerably higher last year than was the average before the war. The graduate in 1914 was receiving a salary on an average of $60 to $75 a month. Last year's graduates received on an average $125 a month.

Concrete Arch of 125-Ft. Span Collapses

According to a brief preliminary report in *Beton und Eisen* of Nov. 28, a rib of a 125-ft. three-hinged concrete arch span under construction over the Bigge River near Siegen, Germany, collapsed on Nov. 3 just after centers were struck. The span was to consist of four ribs carrying an open spandrel deck construction. The crown and skewback hinges were of the plate or spring type. Before striking centers the apparent weakness of the concrete, due to failure to set properly, had been remarked upon. After lowering the centers the rib remained standing free of the centers for half an hour, but then collapsed completely. The accident happened during the noon hour, and in consequence there were no casualties. A full report of the circumstances and causes must await more complete investigation.

Fifth East River Bridge Planned by New York City

New Crossing Between Manhattan and Brooklyn to Be Located at Eighth Street—To Serve Road Traffic Principally

Plans were laid before the Board of Estimate of New York City on Dec. 29 for a new city bridge across the East River, to serve the rapidly growing highway traffic between Manhattan Island and the Boroughs of Brooklyn and Queens. Grover A. Whalen, commissioner of Plant and Structures, in submitting the plans, asked for an appropriation of $200,000 to make borings and surveys and to prepare detailed plans. The general project, however, has already been worked out quite fully, as two drawings reproduced herewith indicate.

At the location selected, Eighth St. (Manhattan), the river is somewhat wider than at the site of the three suspension bridges farther downstream, the Brooklyn, Manhattan, and Williamsburg bridges, the longest one of which has a main span of 1,600 ft. Accordingly, the new bridge will require a span of 1,800 ft. between centers of towers which will be longer than any existing suspension bridge span in the world and exceed by 50 ft. that of the Philadelphia-Camden bridge, now under construction. Structurally it will follow the general type of the Manhattan bridge, the last built of the existing suspension bridges, in having steel towers with fixed base and parallel-chord stiffening trusses continuous from tower to tower and from tower to anchorage. As in the Brooklyn and Manhattan bridges, also, the shore spans will be loaded. The plan shows diagonal stay cables like those of the Brooklyn bridge, which are said to have proved thoroughly satisfactory in that structure. There are to be four cables, carrying a double-deck floor 97 ft. wide center to center of outer stiffening trusses and 114 ft. wide over sidewalks. Two-thirds of the floor space is given over to roadway use, the total width of the four roadway spaces being 118 ft. The stiffening trusses are 30 ft. deep.

While no explorations have been made, it is expected that rock will be encountered at depths not exceeding 100 ft. at the tower and anchorage sites. Basing the substructure calculations on such a depth, the estimate of cost of the structure complete amounts to $27,000,000 (including approaches). Real estate costs will amount to an additional sum of $14,820,000 (properly figured at present assessed valuation). This sum includes more than $9,000,000 for approach roadways, however. The full scheme, including all approach roadways and one item of street widening at some distance from the bridge, amounts to $41,820,000.

Essential features of the approach roadways are a wide boulevard on the Manhattan side, extending back to Fourth Ave. and embracing the block width between Eighth and Ninth Sts.; a large plaza on the Brooklyn side; two street extensions leading from this plaza through the blocks to existing main thoroughfares (Bushwick Ave. and Meeker Ave.); and a viaduct approach connecting the bridge with the Greenpoint district, crossing over McCarren Park. These items of terminal development have been provided in accordance with the traffic demands as shown by experience with the present bridges, including the Queensboro cantilever bridge at 60th St.

Provision of the unusually large roadway width on this bridge (as compared with 57 ft. of roadway on the Queensboro bridge) reflects the fact that the bridge is built essentially for roadway service, and that none of the existing bridges has sufficient roadway capacity to meet the peak-load demand at the present time. Traffic growth has greatly exceeded expectations, as

FIG. 1—EIGHTH STREET LOCATION OF NEW BRIDGE, WITH BROOKLYN OUTLETS BY FOUR MAIN THOROUGHFARES

shown by the fact that the Williamsburg bridge traffic increased in ten years from 6,000 vehicles per day to 23,000 vehicles per day, and that on the Manhattan bridge from 5,000 to 38,000. The Queensboro bridge traffic, intermediate between the two, has shown similar growth. Vehicle traffic over the Brooklyn bridge has always been of much smaller volume, on account of the fact that the bridge accommodates only a single line of traffic in either direction, and has decreased since motor vehicles were barred from the structure last summer in order to segregate horse and motor traffic in the interests of developing maximum bridge capacity. The aggregate traffic capacity of the four bridges is at present fully taxed during peak hours, and congestion often occurs, particularly in the approach roadway.

The project for the new bridge has been developed since last summer, when the decision was reached to reroute bridge traffic so as to restrict the Brooklyn bridge teamways to horse-drawn traffic. At that time study was begun of possible reconstruction of the Brooklyn bridge, and also of the erection of an additional bridge, and the department stated that its policy would be to endeavor to build a new bridge before undertaking any steps toward the reconstruction of the Brooklyn bridge. Mr. Whalen's statement of Dec. 29 to the Board of Estimate, in addition to presenting the results of this study for a new bridge, reported that the study of Brooklyn bridge rebuilding is not complete and will require six months' further time.

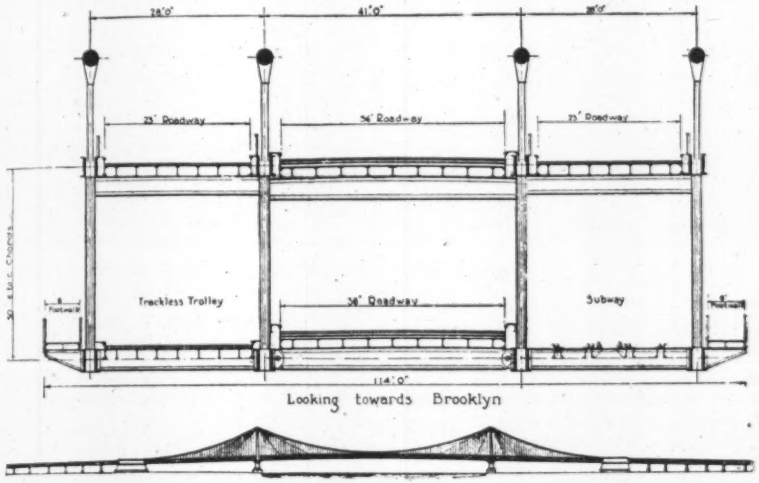


FIG. 2—DOUBLE-DECK, 4-CABLE SUSPENSION BRIDGE OF 1,800-FT. MAIN SPAN

Personal Notes

FULLER & MCCLINTOCK, consulting engineers, New York City, announce the opening of a branch office at 1001 Chestnut St., Philadelphia, for the practice of engineering. The Philadelphia representative will be C. A. Emerson, who for the past nine years has been chief engineer of the State Department of Health of Pennsylvania. Mr. Emerson is a graduate of Beloit College and of the Massachusetts Institute of Technology and previous to his work in Pennsylvania was connected with the construction of the water filtration and softening plant at Columbus, Ohio, the preliminary studies, design and construction of the Baltimore sewage works and various other projects. Fuller & McClintock at present have branch offices in Toledo, Ohio; Memphis, Tenn., and Kansas City, Mo.

JOHN T. FARMER was chosen chairman of the Montreal branch of the Engineering Institute of Canada at its meeting, Dec. 21. O. O. LEFEBVRE was chosen vice-chairman.

D. C. WILLETT has resigned his position as assistant structural engineer with the California State Highway Commission to accept the position of superintendent of construction with the Division of Architecture of California.

GOLDEN, STORRS & CO. have recently opened an office in Hartford, Conn., for the practice of architecture and engineering. Mr. Golden was formerly with Lockwood, Greene & Co. of Boston, and Mr. Storrs has had fifteen years of experience in Worcester, Mass.

L. L. RUSH, assistant engineer of the Kansas Highway Commission, has resigned to accept a position on the engineering force of the Chicago Union Station.

W. V. BUCK, assistant engineer of the Kansas state highway commission, has resigned to enter the automobile business at Newton, Kan.

THOMAS H. MATHER, city engineer of Syracuse, N. Y., has been granted a short leave of absence on account of illness. NELSON F. PITTS, junior assistant city engineer, will be in charge of the office during Mr. Mather's absence.

WILLIAM A. GERE, deputy city engineer of Syracuse, N. Y., will retire on pension Jan. 12 at the age of 60, having served 23 years in the city engineer's department.

C. G. GILLESPIE, after some absence from the department, has returned to the directorship of the Bureau of Sanitary Engineering, California State Board of Health. He succeeds RALPH HILSCHER, who recently resigned.

MANDES GOLDER, formerly division engineer of the Department of City Transit of Philadelphia, Pa., has opened a consulting engineering office at 274 South 20th St., Philadelphia.

ERNEST STATHAM, Great Kills, N. Y., and CECIL M. SHULTIS, New York City, have been appointed junior engineers on the construction of the Hudson River vehicular tunnel.

Obituary

CHARLES F. HEALEY, assistant city engineer of Chicago, died suddenly Dec. 24, 1922, following an operation for appendicitis. Mr. Healey had been in the service of the city of Chicago since his discharge from the Army as engineer of contracts and then as assistant city engineer. Prior to the war he was also connected with the Chicago city engineer's office as a special investigating engineer. Mr. Healey was born in Aurora, Ill., in 1877. His early professional experience was gained with the Illinois Central R.R. and a subsidiary, advancing from rodman to assistant engineer in charge of 500 miles of maintenance-of-way. After leaving the Illinois Central he became associated with the Chicago, Milwaukee & St. Paul Ry. on location and construction and in that work located some of the most difficult parts of the line across the Rockies. In October, 1908, he became associated with Fuller & Manley, consulting engineers of Tacoma, Wash., and for a time he was also a member of the firm of Creelman, Putnam & Healey, engineers and contractors, of Tacoma. During the war Mr. Healey was a captain in the Transportation Division of the American Expeditionary Force

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-19.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Review of Developments During 1922 in the Field of Construction Equipment and Materials

IN THE field of construction equipment and materials the year 1922 was notable not for radical innovations in types, but rather for a multitude of detailed improvements to machines whose basic features of design had become well stabilized through years of manufacture and use. This was to have been expected, for construction has long since become established as one of the nation's great industries and with its growth and the progress made both in engineering design and contracting methods the development of tools has kept pace. To the mechanical genius and the commercial enterprise of the builders of construction plant must be given a large share of the credit for the remarkable results now attained in completing both large and small projects speedily and economically. In the variety and the ingenuity of the mechanical appliances that the constructor finds available for his use the United States occupies an enviable position.

A REVIEW of the year's offerings by equipment manufacturers indicates a few well-defined trends. In so broad a field as that of engineering construction, however, it is difficult to generalize, for each class of work has developed its special mechanical tools and little is gained by attempting to draw conclusions from, let us say, the improved features of a concrete mixer and those of a steam shovel. Nevertheless, a survey of the year's developments shows that manufacturers have been devoting particular attention to the mounting of their equipment and in many cases are altering designs to increase mobility. There has been a decided widening of the field of use of crawler traction, and this type of mounting is now furnished for both light and heavy steam shovels, locomotive cranes, concrete paving mixers, elevating bucket loaders, trench excavating machines, and tractors. Wheel mountings, of course, are still supplied and widely used, but almost every manufacturer of the type of equipment noted above has produced models to meet the growing demand for crawler traction.

EQUALLY marked has been the trend toward the use of rubber tires on a wide variety of construction plant. In this development is seen a desire not merely to increase the mobility of equipment, but also to protect both machines and road surfaces from damage due to the bumping and jolting of heavy bodies when carried on non-resilient tires. It should be recalled that, not so long ago, construction equipment was hauled by horses at slow speeds from one job to another. The motor truck, however, opened up the way for greatly reducing the time lost in such moves, but obviously with ponderous machines on steel-rimmed wheels the potential speeds of the trucks could never be utilized.

The rubber tire, therefore, was the obvious solution to this problem. Under present traffic regulations, also, state highway and city paving officials are insisting upon the protection of road surfaces from the damage by heavy, fast moving vehicles. This condition has been responsible, in part at least, for the wider use of rubber tires on construction equipment, particularly within city limits. Today manufacturers are supplying either solid rubber or pneumatic-tire mountings for such a range of machinery as steam shovels, concrete mixers, portable air compressors, and other types of mobile plant. A further step has been taken by mounting upon motor-truck chassis such machines as concrete mixers and elevating loaders.

OTHER developments during the year have been mainly in details designed to increase the strength of machines, simplify their control, increase their output, and lower their cost of operation. Based upon the results of a canvass of manufacturers by *Engineering News-Record*, the following recital of the year's progress is presented. The material has been grouped into divisions representing the main classes of construction equipment and materials. In each division a summary of the more important improvements precedes more detailed statements covering the products of each manufacturer from whom replies were received:

Scope of Review

Power Shovels
Chuting Plant
Industrial Locomotives
Elevating Loaders
Rock Crushers
Gasoline Engines
Air Compressors and Pneumatic Tools
Concrete Mixers
Hoists
Locomotive Cranes
Reinforcement
Cableway Excavators
Buckets
Road Building Equipment
Trucks and Tractors
Pipe
Dump Cars and Wagons
Road Rollers

Power Shovels

IN THE power-shovel field the outstanding developments of the year included: (1) the application of the Diesel engine, as the source of power, to a type of equipment ordinarily operated by steam and gasoline engines or electric motors; (2) increased use of the continuous-tread type of mounting—particularly the introduction of crawler traction for the heavy-duty type of railroad shovel; (3) improvements in power steering equipment from the cab; and (4) rubber-tired wheels for work involving frequent moves from one job to another over paved streets within city limits. In addition, scores of less important improvements have been made. In general, the aim of changes in design is to produce equipment which one maker describes as "abuse-proof." This result is being sought by the introduction of larger bearings and heavier shafts at points of severe wear. In other words, the manufacturers are providing oversize parts at critical points. Cut gears are now generally employed and a more liberal use of manganese

steel, both for gears subjected to vibration and shock and for dipper fronts, is indicated.

A number of improved features have been incorporated in the design of the revolving type shovel to facilitate the conversion of this equipment for dragline or clamshell bucket use. In addition, the standard types may be equipped with special booms for high lifts.

While the use of crawler traction for power shovels dates back considerably further than the year just passed, manufacturers have been devoting a great deal of attention to this feature of their equipment. Particular stress has been laid upon the development of crawler treads to avoid clogging with mud or small stones and to prevent cutting or otherwise damaging paved surfaces. With these ends in view some designers have called for steel castings which overlap and which have rounded edges. Treads and links have been combined into integral steel castings with smooth surfaces. The use of chains in the driving mechanism for the crawler treads has, in some cases, been eliminated. For the revolving type shovels the crawler mounting usually consists of two units, one on each side, but in the case of the heavier railway type of shovel four crawler units are provided, two at the forward end replacing the usual jack arms and two at the rear.

On the whole there have been during the past year few changes in the basic design of power shovels, although a great many details have been altered to facilitate operation, increase the strength and ruggedness of the equipment, enhance its mobility, and simplify interchangeability for dragline or crane-bucket work. In the following paragraphs are noted some of the detailed improvements that have been made by individual power-shovel manufacturers.

Bucyrus Co.

ONE OF THE most important developments was the equipment of a Bucyrus 1-yd. shovel with a 55-hp. mechanical injection oil engine of the Diesel type, for which substantial economies are claimed. To date the use of this type of engine has been limited to the 1-yd. shovel and dragline, but the company expects, in the near future, to install it on other sizes. The Diesel power unit is a four-cycle, slow-speed, heavy-duty, 8x10½-in. engine, operating at 360 r.p.m. Where a shovel or dragline line is handling an average of 600 to 700 cu.yd. of material per day under normal operating conditions, the company claims that the Diesel engine consumes from 1¾ to 2¼ gal. of fuel oil per hour. At a cost of 6c. per gallon, the expense for fuel for an 8-hr. shift figures at between $1 and $1.25.

A new feature on the revolving shovel was introduced to improve and simplify the thrusting operation. It involves the use of a rope-thrust, eliminating a power unit on the boom and the usual belts, chains and telescopic shafting. With the power transmission scheme adopted it is also possible to shake the dipper.

Improvements in the ¾-yd. revolving shovel included a two-part hoist, two propelling speeds, and the making of the dipper with rounded corners to free itself more easily from sticky material.

The Bucyrus Co. claims to be the first manufacturer to employ crawler traction mounting for the heavy railroad type of shovel. This type of mounting may be had with new machines or applied to shovels already in the field. The mounting consists of two forward and two rear sets of crawler units. Propelling is accomplished through the front crawlers. The use of this equipment, it is pointed out, eliminates the necessity of rail and jacks, and allows the shovel to be quickly moved out of the way during blasting operations.

Erie
Steam Shovel Co.

HEAVIER shafts and larger bearings at points of severe wear have featured improvements on Erie shovels during the year. The idea has been to make the equipment not only oversize for ordinary service, but practically abuse-proof. A propelling shaft 3¾ in. in diameter has been adopted to withstand severe strains, caused, for example, when the treads of a crawler type machine freeze into the ground. Split collars are provided on the rear axle of traction wheel machines to throw propelling gears out of mesh when the shovel is towed by a truck or tractor.

An automatic tripping device has been introduced. It consists of a drum which turns with the dipper shaft and keeps the trip rope taut. Another detail is the auxiliary exhaust through which water may be blown out instead of projected through the stack.

Fairbanks
Steam Shovel Co.

A FEATURE introduced on the ¾-yd. Fairbanks power shovel was a horizontal digging boom and dipper handle, intended to give a longer reach and dumping range than is obtainable with other types. The dipper handle is hinged to a trolley which is operated back and forth on the horizontal digging boom by cables fastened to a small drum on the trolley and a friction drum on the A-frame.

Marion
Steam Shovel Co.

WHILE STEAM still maintains the leading position in shovel construction, according to the Marion Steam Shovel Co., it no longer lays claim to dominance in such industries as have standardized with electric equipment or in localities where coal costs are high, smoke ordinances in force, or boiler feed water difficult to get. These conditions led to the introduction, on three models—¾, 1¼ and 1¾-yd.—of independent three-motor electric drives for the hoisting, rotating and crowding operations. On the all-electric type a direct-connected motor generator set is installed, while on the gasoline-electric outfit the power unit consists of a heavy-duty vertical type gasoline engine and electric generator.

On a new line of small revolving steam shovels in three models a power steering arrangement is provided which is entirely controlled by the operator without outside assistance. All clutches may be disengaged when the shovel is to be towed from one site to another. A four-belt flexible type of crawler truck is furnished for the ¾-yd. shovel if preferred to the two-belt type. Other optional mountings include rubber-tired wheels.

The Marion company also has adapted crawler traction to its railroad type shovels, an improvement which is regarded by the company as the most important that has been made to railroad type shovels during the past 15 years.

Osgood Co.

IMPROVEMENTS designed to increase the speed and ease of operation of its ¾ and 1-yd. shovels have been introduced by the Osgood Co. Among them are included a simplified continuous tread mounting with improved power steering; a redesigned main body; and a new type of dipper. The crawler tread links are in one piece and have high guiding flanges moving over round rollers set in rigid side frames, holding the treads in their course and preventing side slipping. Round tumblers with teeth on the sides engage with the guiding flanges, thus driving the tread belt and eliminating sprocket holes which become clogged with dirt and stones.

Driving power is delivered direct to the axles by gears, bearings have been reduced to a minimum and sprockets and drive chains eliminated.

The revolving shovel is convertible for dragline or clam-shell work and has drums powerful enough to handle the buckets with a single line. This feature, it is pointed out, does away with a set of sheaves on the buckets, reduces wear on lines, and materially speeds up operation.

Thew
Shovel Co.

ONE OF THE most important improvements in Thew shovels has been in the continuous tread truck, to which has been added a power steering equipment and two speeds. The treads are of the semi-flexible type with chain drive. They are 26 in. wide and are cambered on the end as well as beveled, to minimize damage to pavements and subgrades during turning. The opening between pairs of treads is claimed to give greater traction. The two speeds with this type of machine are 65 and 42 ft. per minute.

On the company's gasoline shovel a four-cylinder, heavy-duty type engine has been substituted for the two-cylinder engine formerly used.

Concrete Chuting Equipment

CONSTRUCTION work calling for the distribution of substantial yardages of concrete over relatively large areas has led to many developments in chuting equipment. Such projects as covered reservoirs, large industrial plants, bridges, and sewage disposal works offer fertile fields for the application of this type of plant. Major improvements dur-

ing the year have included equipment for handling aggregate in which large stone is used, particularly on dam construction, changes in details of the system of double-counterweight chutes, and the design of equipment for the so-called smaller concrete jobs such as buildings, short-span bridges, retaining walls and silos.

Insley Manufacturing Co.

DERRICK-SUPPORTED chutes are now commonly used on a wide variety of large-scale public works construction where concrete is mixed at a point where materials may be delivered easily, then chuted to a mast hopper located on a derrick and distributed from that point as the center. The Insley company states that with its system of double-counterweight chutes concrete may be placed at any point within the area of a 300-ft. diameter circle, the fact that no ground supports, except the main mast, are required for chuting making it easy to clear the reinforcing steel.

The most marked development covered by the year's experience of the Insley organization falls within the class of jobs calling for a comparatively small yardage of concrete. This type of work is represented by retaining walls, small bridges and buildings, and farm structures. Requirements of low first cost and low cost of erection led to the development of simple mast hoist bucket equipment.

Lakewood Engineering Co.

AN INCREASING tendency toward the use of steel towers is noted by the Lakewood Engineering Co., which has developed new designs for chuting equipment during the year in which the number of parts has been decreased and provision made for easier panel erection in the field. Details have been changed to increase the strength of towers. One of the important developments during 1922 has been the use of chutes of larger diameter than were before employed. On large dam construction chutes of 18 in. diameter have been developed to distribute concrete in which large aggregate—from 6 to 8 in. in diameter—is distributed.

Industrial Locomotives

WIDER ranges of speed, with gear drive, have characterized the newer types of industrial locomotives. Four speeds, either forward or reverse, are provided for in models announced last year by two manufacturers. One of these was a 4-ton and the other a 7-ton unit.

Fate-Root-Heath Co.

SPECIALLY designed transmission, giving speeds of 2½, 4, 8 and 12 miles per hour, either forward or reverse, is the feature of the 7-ton gear-drive locomotive developed by the Fate-Root-Heath Co. Tests of this machine showed a draw-bar pull of 5,250 lb. in low gear with sanded rails. All gears are large and massive, the final drive gear having a 14½-in. diameter and a 4-in. face. The power plant is a Buda heavy-duty, four-cylinder gasoline engine with a Modine sectional core radiator.

Geo. D. Whitcomb Co.

TO ITS line of haulage machinery the Whitcomb company last year added a new type of 4-ton gear-drive gasoline locomotive, equipped with four speeds in each direction—3, 6, 9 and 12 miles per hour. This unit is equipped with a 4 x 5-in. Wisconsin over-head valve motor and is designed for the needs of the contractor employing the smaller type of gasoline locomotive.

Elevating Loaders

MOUNTINGS on crawler traction and, in cases where a great degree of mobility is desired in making frequent moves from one job to another, on tractors or motor trucks, are now common in the portable elevating bucket loader field. The increased headroom demanded for loading the larger sizes of motor trucks and provision for various attachments supplied with loaders have resulted in the development of much taller and heavier machines than formerly. These changes in design have naturally resulted in wider and larger wheel bases and axles of greater diameter. Gathering devices to aid the loading of materials spread in thin layers are now standard equipment and overhead storage hoppers to permit the continuous operation of the loaders during the absence of trucks have added to the efficiency of this type of equipment. Swivel spouts facilitate the discharge of material into trucks, while present practice has introduced two and three-speed self-propelling mechanism, for moving and feeding into the pile.

Barber-Greene Co.

AN ELEVATING bucket loader with practically double the capacity of its previous models was brought out by the Barber-Greene Co. during the year. The rated output is 1¾ cu.yd. per minute and embodies a number of special features. Among them are a standard motor-truck transmission making possible three speeds when working into the pile and one speed in reverse, as against two speeds in previous types. The machine is mounted on crawlers of increased width and length, the new width being 10 in., as against 8 in., and the new length 60 in. as against 56 in. The buckets also have been increased in size and now measure 20 in. across the cutting edge as compared with 16 in. previously employed. On this new model the buckets are staggered slightly, resulting in a cutting path 22 in. wide. The revolving feeding disks have been improved by an adjustment which enables them to be raised and lowered independent of the boom. The same type of Buda gasoline engine is used as in former models, although increased horsepower has been introduced in the new type.

Geo. Haiss Manufacturing Co.

A MOTOR truck mounting for its path-digging bucket elevator, to meet requirements for rapid loading with a single unit at a number of widely separated points, was announced by the Haiss company last year. The regular A-frame supports on which the elevator is pivoted are erected over the rear axle of the truck and the necessary transmission, gearing, chains, etc., are placed as on standard loaders. Revolving propellers aid in feeding material to the bucket.

Increased mobility also was secured in the case of the lighter wagon loaders and portable belt conveyors by mounting these machines on Fordson tractors. During the year a snow-loader was developed in which the loading element consists of a steel pan conveyor with path-digging feeding propellers.

Jeffrey Manufacturing Co.

CRAWLER traction with wide treads—12-in. steel plates—is one of the features of the Jeffrey company's new Tanktred bucket loader, designed to dig into a pile to an unusually great depth. The digging edge of the buckets has a cutting clearance at all points and the foot of the elevator is constructed so that the buckets are wider than any other part. Another improvement is the use of a large foot wheel which, by reducing centrifugal force, facilitates the picking up of material and prevents the buckets from kicking away large lumps. On this unit two speeds are provided, one a traveling speed and the other a feeding speed.

A detachable gathering device similar to a road scraper has been designed to aid in gathering up and loading material spread out in a thin layer.

To increase the efficiency of the plant by keeping the loader in operation during the absence of a motor truck a storage hopper is provided overhead to receive the discharge from the buckets. A universal swivel spout is an additional help in directing the point of discharge of the elevated material. Of late it has been necessary to increase the headroom under loaders and in the case of the present equipment a clearance of 9½ ft. is provided.

Link-Belt Co.

A POWER swiveling principle was incorporated in the industrial bucket loader, announced last year by the Link-Belt Co. In operation it backs into a pile of material under its own power and cuts a complete semicircle while digging and loading. The buckets on every machine are of two types, one with round and the other with straight cutting edge, mounted alternately on the same belt. To insure maximum digging efficiency the round buckets are provided with steel teeth at the center while the rectangular buckets have steel teeth on the ends and sides. The equipment is mounted on a four-wheel truck and has a capacity of 45 cu.ft. per minute. The power unit is a 15-20 hp. gasoline engine giving speeds of 5 ft. and 75 ft. per minute forward or backward. An overhead storage hopper of 1-yd. capacity receives the discharge from the buckets and for industrial use, particularly in loading trucks, a swivel chute rotating 180 deg. is provided.

Portable Machinery Co.

IN ITS scoop conveyor of the endless belt type the Portable Machinery Co. has adapted to general construction purposes equipment originally designed for coal handling. The principal change

has involved a new type of carrying trough, in which the conveying belt travels between, instead of under, the skirt plate. This feature is claimed to reduce friction and increase the life of the belt. The electric motor or gasoline engine power unit on this equipment is mounted over the trough on vibrationless supports to minimize fouling by dust and dirt.

Rock Crushers

SUBSTITUTION of cast steel for the grey cast iron generally used in the frames and crowns of gyratory crushers marked one of the chief advances during the year. For the utilization of local materials in road-building, mobile units comprising rock crushers mounted on wheels and portable screening plants and storage bins have been developed.

Smith
Engineering Works

THE NEW Telsmith primary breaker is equipped with the cast-steel frame and crown noted in the foregoing paragraph. To date cast-iron frames and crowns have been regarded as standard equipment. In the past, to be sure, the purchaser who desired a cast-steel crusher could secure it by paying the price. This equipment, however, was special and when ordered had to be made from patterns designed generally for the manufacture of grey-iron castings. Consequently more metal was furnished than was necessary and the cost was high. Now, however, the Smith organization is standardizing on cast-steel equipment and using patterns designed for manufacture in cast steel, thus making it possible to produce these machines at a cost slightly in excess of that for a cast-iron crusher. Advantages claimed for the cast-steel crusher are its durability particularly in the event of "tramp" iron entering with a charge of rock. The accidental entry of this material into a grey iron crusher generally results in serious damage. The cast-steel equipment, it is claimed, will successfully withstand this test.

To Be Continued in Next Week's Issue

Business Notes

NORTHWEST ENGINEERING Co., Chicago, announces that H. A. Hutchins, formerly with the Thew Shovel Co., has become associated with its main office in Chicago. Mr. Hutchins had been with the sales force of the Thew company since 1917 and was district manager of the Chicago territory of that company up to the time of joining the Northwest organization on Dec. 15.

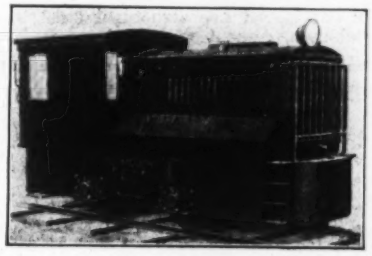
MONARCH TRACTORS, INC., Watertown, Wis., has gone into overtime production of a six-cylinder tractor. The company has spent a year in developing and perfecting this new model.

BUCYRUS Co., South Milwaukee, Wis., announces the addition to its sales force of John J. Gault. He has had many years of experience as construction and locating engineer, having been assistant engineer on the Chicago & Northwestern, engineer maintenance of way on the Chicago & Alton, construction engineer for the United Fruit Co. and assistant engineer on the Chicago, Milwaukee & St. Paul. His latest connection was with the International Harvester Co. as locating engineer on a railroad project. Mr. Gault will be attached to the Chicago office of the Bucyrus Co. at 622 McCormick Building.

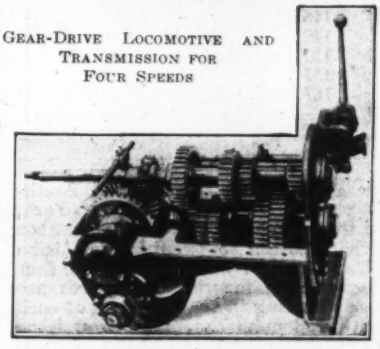
Equipment and Materials

Four-Speed Gasoline Locomotive Shows High Draw-Bar Pull

A draw-bar pull of 5,2550 lb. in low gear with sanded rails has been developed by the four-speed, 7-ton gear-drive locomotive announced by the Fate-Root-Heath Co. of Plymouth, Ohio. Among the features of this equipment is the transmission, giving a range



GEAR-DRIVE LOCOMOTIVE AND TRANSMISSION FOR FOUR SPEEDS



of speeds of 2½, 4, 8, and 12 miles per hour, either forward or reverse, and an additional final drive and gear shaft. The gears are large and massive, the final drive gear having a 14½-in. diameter and a 4-in. face. This gear permits of the proper speed reduction and also places the sprocket shaft which it drives in the same plane as the axles. The other gears have 2 and 2½-in. faces respectively.

Sliding gears are made in pairs on the second driving shaft. The gears that are driven are the only ones in mesh. Forward and reverse speeds are obtained by large bevel gears with internal gear teeth into which the pinion that drives the main gear meshes, thus eliminating jaw clutches. All gears are of alloy hardened steel, mounted on extra large shafting and ball bearings. These ball bearings are all inside the gear case, from which they receive lubrication, and insure permanent alignment. The final drive is by means of two short heavy chains, one for each axle, driven direct from the transmission.

The power plant is a Buda heavy duty, four-cylinder gasoline engine, with a Modine sectional core radiator. The clutch is of the dry-plate type, with nine driving discs faced on each side with non-burnable facings. The axles are mounted on Hyatt roller bearings and the axle springs are 12¾ in. long to enable the wheels to follow uneven track.

The frame is built close to the track and the cab, of all-steel construction, is fitted with wire-glass windows. The overall length of the locomotive is 144 in., its height, 72 in., and its width, from 51 to 64½ in., depending upon the gage of track. A range of gages from 23⅝ to 56½ in. is provided for.

New Cement Handling and Loading Device Being Perfected

To supplement the service of its Batcherplant for storing and measuring sand and stone and delivering this material into motor trucks or industrial railway cars, the Blaw-Knox Co., Pittsburgh, is developing equipment for the rapid handling and loading of cement into mixers. The device, which is not yet on the market, consists of two main parts. The first part is a steel box-shaped truck partition, from one to four of these being furnished, depending on the number of compartments desired in the truck. The box itself has a bottom gate and a specially designed cover to protect the cement from moisture. In operation the box-shaped cement partition is released exactly in the same way as the ordinary truck partition and as the sand and stone are dumped the cement automatically goes with it. This arrangement is designed to eliminate handling of cement at the mixer when sacks are emptied into the skip.

The second part of the equipment is a rapid cement-loading device. Trucks, before or after receiving premeasured charges of sand and stone, will drive past the cement shed and receive the measured cement from steel batchers or hoppers dumping directly into the cement compartments of the truck. The equipment, its manufacturers predict, will eliminate a number of laborers ordinarily needed in concrete mixing operations, will speed up work, and will reduce cement losses.

Publications from the Construction Industry

Brick Houses—COMMON BRICK MANUFACTURERS ASSOCIATION OF AMERICA, Cleveland, Ohio, has published a 64-page illustrated booklet showing plans and photographs of sixty residential brick houses, for which 10c. is charged. A separate circular giving the range of cost of houses and prices of detailed plans may be secured from the association.

Paving Mixer Performance—T. L. SMITH Co., Milwaukee, is distributing a folder covering performance records of its model 21-E paving mixer. Day-by-day performance data on a large trunk highway job are given together with a number of photographs showing the mixer, which is of the boom-and-bucket type, in action.

Business Side of Construction

Facts and Events that Affect Cost and Volume

A Ten Year Résumé of Construction Cost

On these two pages the E. N.-R. Cost Index is given for every month since 1913, together with the derivation. The Volume Index Number also is given for the months and years of 1920, 1921 and 1922. Spring prices of construction materials are listed for the last ten years.

E. N.-R. Cnnstruction Cost Index Number

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is a national index of general construction cost in the United States. For that reason in its computation only the great basic materials and common labor are considered. Steel, cement and lumber are the fundamental materials of the construction industry, and the rate paid common labor eventually determines the cost of labor.

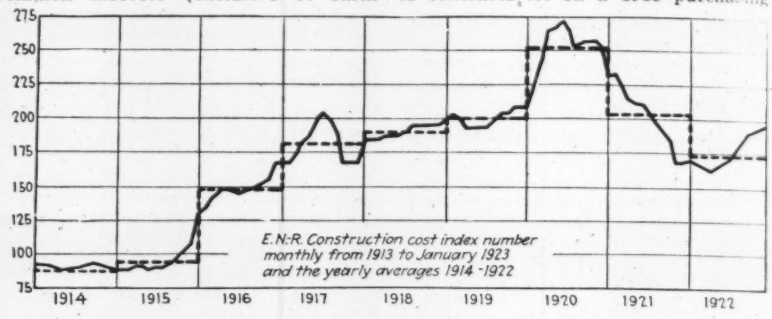
The importance of the cost of brick, sand, gravel, crushed stone, and the rest, is not minimized; but these materials are usually produced locally and their prices are subject to fluctuating local conditions.

The *Engineering News-Record* Construction Cost Index Number is not referred to Boston or Seattle, to Minneapolis or El Paso but to the 3,507,640 sq.mi. of the United States. Change in towing rates on the Hudson River will affect the price of brick or crushed stone, alongside dock, New York, without making any change whatever in the nationwide cost of construction. On the other hand, a price movement in either steel, cement or lumber wields an influence that is almost invariably continental in scope.

The *Engineering News-Record* Construction Cost Index Number is based on the prices of steel, cement, lumber and common labor in 1913. Furthermore, these materials and common labor are weighted according to their relative importance as adjudged by *Engineering News-Record*. These weightings are: Steel, 37.50 per cent; cement, 7.14 per cent; lumber, 17.10 per cent; labor, 38 per cent. The weightings were determined by studying the annual production of the three prime materials and the number of common laborers (exclusive of farm labor) in the United States. The markets considered are structural steel in Pittsburgh, cement without bags f.o.b. Chicago; 3 x 12-in. to 12 x 12-in. Southern pine to contractors in New York, and the average price of common labor in the eighteen to twenty cities listed in *Engineering News-Record* in the first issue of each month. The prices are those obtaining in the last week of each month and published in the first issue of each month. The quantities of these materials and the number of man-hours used in computing the Index Number were selected so that the total cost (quantities multiplied by prices, and added together) for 1913 would be $100 for a "unit of construction."

For example, if the quantities are 2,500 lb. of structural steel, six barrels of cement, 600 ft.b.m. of lumber, and 200 man-hours, and the prices are $1.50 per 100 lb. for shapes, $1.19 per net bbl. of cement, $28.50 per M ft.b.m. of lumber, and 19 cents per hour for common labor, the total computation will be $99.74; 100 is the base *Engineering News-Record* Construction Cost Index Number.

The accompanying tabulation gives the *Engineering News-Record* Construction Cost Index Number for every month from 1913 to December, 1922, while the chart gives both the monthly and yearly numbers. The current index number is presented in its regular form on p. 4 of this section.



E. N.-R. Construction Volume Index Number

The *Engineering News-Record* Volume Index Number, placing the value of contracts let on a 1913 purchasing basis, was announced in the issue of Oct. 20, 1921, p. 670. Its purpose is to show the actual amount of contracts let in prewar years rather than the actual money value of contracts let. It is based on 1913—despite the fact that this was a sub-normal construction year by fifteen to twenty-five per cent—for two reasons: 1913 is the last pre-war year and most index numbers (including *News-Record's* Construction Cost Index Number) are based on 1913 basis. The year 1913 was normal neither as regards the volume of construction nor the monthly distribution as shown by contracts awarded. To

ENGINEERING NEWS-RECORD CONSTRUCTION COST INDEX NUMBER—1914 TO 1922

	1914	1915	1916	1917	1918	1919	1920	1921	1922
January	89.22	87.12	130.46	167.75	184.51	198.05	206.55	230.87	168.72
February	89.22	87.36	134.46	167.75	184.51	201.50	225.10	230.67	168.72
March	88.97	87.66	142.96	175.66	184.51	198.05	240.85	224.27	162.04
April	87.97	90.16	147.31	183.41	186.01	191.25	265.20	213.07	164.72
May	88.62	90.16	148.86	187.61	186.01	191.25	268.90	210.82	164.62
June	87.87	88.96	146.51	199.26	186.31	191.85	273.80	209.82	166.62
July	88.12	90.51	145.76	204.01	188.65	193.65	265.65	203.82	169.70
August	90.11	91.76	146.56	198.41	193.85	196.65	252.00	193.07	173.40
September	90.36	93.01	149.56	190.31	193.85	202.85	255.20	188.27	185.00
October	88.51	96.16	152.91	167.11	193.85	202.25	255.20	182.57	188.60
November	87.26	101.06	155.66	166.51	193.55	206.85	255.32	166.32	188.60
December	86.51	107.06	167.15	167.11	194.75	206.85	251.62	167.82	192.60
Averages	88.56	92.58	147.35	181.24	189.20	198.42	251.28	201.78	174.45

E. N.-R. CONSTRUCTION VOLUME INDEX NUMBER

1913 and 1920 to 1922

(1913 = 100)

	1922	1921	1920
January	91	41	146*
February	100	43	114
March	202*	88*	107
April	150	86	142*
May	179	90	107
June	187*	117*	74
July	118	90	85*
August	154*	94	65
September	129	114*	85*
October	127	109	73
November	122*	101	51
December	111	118*	58*

* Taken from five issues of *Engineering News-Record* during month.

correct the latter condition current monthly volumes are compared with the average monthly value of contracts let in 1913. As an example the value of contracts in December, 1913, which was $63,341,000, is not compared with the value of contracts let in December, 1922, which was $123,143,000, but with the average monthly value in 1913, which was $57,545,000.

Letting C represent the value of contracts let in 1913 (or any fraction of 1913), C_1 the value for 1922 (or the same fraction of 1922), I the *E. N.-R.*, Construction Cost Index Number for all or the considered part of 1913, and I_1 the Cost Index Number for all or the same part of 1921, the formula for computing the Valume Index Number is:

$$\textit{Vol. Index No.} = \frac{\frac{C_1}{I_1}}{\frac{C}{I}} = \frac{IC_1}{I_1C}$$

But I and C are constants—100 and $57,545,000 (for any month of 1913) or 100 and $690,540,000 for the whole of 1913; therefore,

$$\textit{Monthly Vol. Index No.} = \frac{C_1}{575{,}450I_1}$$

$$\textit{Yearly Vol. Index No.} = \frac{C_1}{6{,}905{,}400I_1}$$

Spring Prices of Materials Since 1913

Engineering News-Record's comparison of spring prices of construction materials has been published once a year since 1919. The large tabulation brought to date is the same as last year's, with the addition of the average common labor rate over the country.

The smaller table shows the per cent change in prices of some of the principal materials from the average spring prices since 1913. Structural shapes and reinforcing bars are 16 and 12 per cent, respectively, less than the average. Linseed oil is 7 per cent under, compared with -27 a year ago.

PRICE SITUATIONS IN SPRING, 1919, 1921 AND 1922

(+indicates increase; — indicates decrease)

Materials	Per Cent Change, January, 1919, from General Average of Spring Prices, 1913-1918	Per Cent Change, March, 1921, from General Average of Spring Prices, 1913-1920	Per Cent Change, Dec. 15, 1921, from General Average of Spring Prices, 1913-1921	Per Cent Change, Dec. 14, 1922 from General Average of Spring Prices, 1913-1922
Crushed stone, New York	+ 42	+ 61	+ 32	+ 22
Sand, New York	+100	+ 42	+ 27	+ 23
Gravel, New York	+120	+111	+ 14	+ 28
Cast iron pipe, New York	+ 91	+ 45	+ 9	+ 22
Structural shapes, New York	+ 52	+ 14	— 18	+ 3
Tank plates, New York	+ 58	+ 17	— 11	+ 3
Linseed oil, New York	+ 62	— 36	— 27	— 7
Freight Pittsburgh to New York or Chicago on finished steel products	+ 35	+ 95	+ 76	+ 48
Steel sheetpiling, Pittsburgh mill	+105	+ 10	— 18	+ 16
Structural shapes, Pittsburgh mill	+ 56	— 6	— 39	— 16
Reinforcing bars, Pittsburgh mill	+ 58	+ 6	+ 15	— 12
Reinforcing bars, New York warehouse	+ 51	+ 11	— 47	+ 26
Average	+ 69	+ 31	+ 1	+ 13

ENGINEERING NEWS-RECORD COMPARISON OF SPRING CONSTRUCTION MATERIALS PRICES SINCE 1913

All Prices New York Except Otherwise Stated

	Portland Cement, per bbl. net, with-out bags, Chicago	Southern Pine, 3x12 to 12x12, 20 Ft. and Under	Common Brick (per M.)	Crushed Stone (per Cu.Yd., 1 In.)	Sand (per Cu.Yd.)	Gravel (per Cu.Yd., 1-in.)	C.-I. Pipe (6 In. per Ton)	Beams and Channels 3-15-In per 100 lb.)	Beams, Etc., Pittsburgh Mill	Reinforcing Bars, 2-In. and Larger, Pittsburgh Mill	Reinforcing Bars, 1-In. and Larger	Steel Sheetpiling, Pittsburgh Mill	Tank Plates 1-In. and heavier per 100 Lb.	Hollow Tile (6x12x 12 per Block), Factory, Perth Amboy, N. J.	Linseed Oil (Raw in Barrels)	Freight to Pitts-burgh on Steel (per 100 Lb.)	Average Common Labor Rate per Hr. for U. S.
April, 1913	$1.19	$28.50	$7.00	$0.90	$0.50	$0.85	$24.00	$2.15	$1.70	$1.50	$2.25	$1.60	$1.61	$0.084	$0.48	$0.16	$0.17
May, 1913	1.19	28.50	7.00	.90	.50	.85	23.50	2.15	1.65	1.50	2.25	1.60	1.61	.084	.50	.16	.17
June, 1913	1.19	28.50	7.00	.90	.50	.85	23.00	2.15	1.50	1.50	2.25	1.60	1.61	.084	.48	.16	.17
Average	**$1.19**	**$28.50**	**$7.00**	**$0.90**	**$0.50**	**$0.85**	**$23.50**	**$2.15**	**$1.62**	**$1.50**	**$2.25**	**$1.60**	**$1.61**	**$0.084**	**$0.49**	**$0.16**	**$0.17**
April, 1914	$1.12	$28.50	$5.50	$0.95	$0.50	$0.90	$22.00	$1.95	$1.15	$1.20	$2.25	$1.60	$1.31	$0.084	$0.54	$0.16	$0.18
May, 1914	1.12	30.00	5.50	.95	.50	.90	22.00	1.85	1.15	1.15	2.25	1.60	1.31	.084	.54	.16	.18
June, 1914	1.12	30.00	5.60	.95	.50	.90	20.50	1.85	1.10	1.15	2.25	1.60	1.31	.084	.53	.16	.18
Average	**$1.12**	**$29.50**	**$5.55**	**$0.95**	**$0.50**	**$0.90**	**$21.50**	**$1.85**	**$1.13**	**$1.17**	**$2.25**	**$1.60**	**$1.31**	**$0.084**	**$0.54**	**$0.16**	**$0.18**
April, 1915	$1.11	$28.50	$5.50	$0.90	.....	$0.85	$20.00	$1.90	$1.15	$1.15	$1.95	$1.60	$1.36	.....	.....	$0.169	.18
May, 1915	1.11	28.50	5.75	1.05	.....	.85	20.50	1.90	1.20	1.15	2.00	1.50	1.32	.....	.....	.169	.18
June, 1915	1.15	26.50	6.00	1.05	.....	.85	22.00	1.90	1.20	1.20	2.00	1.50	1.37	.....	.....	.169	.18
Average	**$1.12**	**$27.75**	**$5.75**	**$1.00**	.....	**$0.85**	**$20.75**	**$1.90**	**$1.18**	**$1.17**	**$1.97**	**$1.53**	**$1.35**	.....	.....	**$0.169**	**$0.18**
April, 1916	$1.42	$31.50	$8.50	$0.95	$0.40	$0.80	$30.50	$2.50	$2.50	$2.45	$3.10	$2.50	$2.50	.....	$0.81	$0.169	$0.18
May, 1916	1.46	31.50	7.25	.95	.40	.85	30.50	2.50	2.75	2.50	3.25	2.50	2.65	.....	.81	.169	.18
June, 1916	1.46	30.50	8.00	.95	.50	1.00	30.50	2.60	2.75	2.50	3.10	2.50	2.75	.....	.....	.169	.18
Average	**$1.45**	**$31.00**	**$7.90**	**$0.95**	**$0.45**	**$0.90**	**$30.50**	**$2.55**	**$2.67**	**$2.47**	**$3.15**	**$2.50**	**$2.65**	.....	**$0.81**	**$0.169**	**$0.18**
April, 1917	$1.76	$32.75	$9.50	$1.20	$0.50	$1.25	$47.50	$3.75	$3.88	$3.35	.....	.....	$5.00	.....	$1.04	$0.169	$0.28
May, 1917	1.90	34.75	11.50	1.25	.50	1.35	55.50	3.80	4.00	3.50	.....	.....	5.50	.....	1.21	.169	.28
June, 1917	1.91	39.75	10.25	1.25	.50	1.25	55.50	5.00	4.31	3.50	.....	.....	7.00	.....	1.31	.169	.28
Average	**$1.86**	**$35.75**	**$10.40**	**$1.25**	**$0.50**	**$1.30**	**$51.70**	**$4.15**	**$4.06**	**$3.45**	.....	.....	**$5.80**	.....	**$1.19**	**$0.169**	**$0.28**
April, 1918	$1.96	$42.75	$10.25	$1.75	$1.25	$2.00	$55.35	$4.20	$3.00	$2.90	$4.09½	$3.10	$4.45	$0.14	$1.55	$0.195	$0.37
May, 1918	1.96	42.75	10.00	1.75	1.25	2.00	55.35	4.20	3.00	2.90	4.09½	4.00	4.45	.14	1.55	.195	.37
June, 1918	2.00	43.25	10.25	1.75	1.25	2.00	61.35	4.20	3.00	2.90	4.09½	4.00	4.45	.14	1.58	.195	.37
Average	**$1.97**	**$43.00**	**$10.15**	**$1.75**	**$1.25**	**$2.00**	**$57.35**	**$4.20**	**$3.00**	**$2.90**	**$4.09½**	**$3.70**	**$4.45**	**$0.14**	**$1.56**	**$0.195**	**$0.37**
April, 1919	$2.00	$45.00	$15.00	$1.75	$1.25	$2.00	$57.70	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.159	$1.55	$0.27	$0.46
May, 1919	2.00	45.00	15.00	1.75	1.25	2.00	57.70	3.47	2.45	2.35	3.37	2.55	3.67	.153	1.63	.27	.45
June, 1919	2.00	46.00	15.00	1.75	1.25	2.00	52.70	3.47	2.45	2.35	3.37	2.55	3.67	.153	1.76	.27	.45
Average	**$2.00**	**$45.50**	**$15.00**	**$1.75**	**$1.25**	**$2.00**	**$56.03**	**$3.47**	**$2.45**	**$2.35**	**$3.37**	**$2.55**	**$3.67**	**$0.155**	**$1.65**	**$0.27**	**$0.45**
April, 1920	$2.00	$72.00	$18.00	$2.00	$1.25	$2.25	$72.30	$5.00	$4.00	$4.00	$5.00	$3.65	$5.00	$0.2274	$1.87	$0.27	$0.55
May, 1920	2.08	70.00	18.00	2.15	1.50	2.50	76.30	5.00	4.00	4.00	5.00	3.65	5.00	.2274	1.87	.27	.57
June, 1920	2.15	70.00	18.00	2.15	1.50	3.00	76.30	4.47	4.00	3.75	5.00	3.65	4.67	.....	1.73	.27	.58
Average	**$2.08**	**$70.50**	**$18.00**	**$2.10**	**$1.42**	**$2.58**	**$74.97**	**$4.83**	**$4.00**	**$3.92**	**$5.00**	**$3.65**	**$4.89**	**$0.2274**	**$1.83**	**$0.27**	**$0.57**
April, 1921	$2.17	$48.00	$16.00	$1.95	$1.25	$2.50	$63.30	$3.33	$2.00	$2.00	$3.28	$2.55	$2.00	.....	$0.73	$0.38	$0.56
May, 1921	2.17	48.00	15.00	1.95	1.25	2.50	63.30	3.33	2.20	2.10	3.38	2.55	2.40	.....	.67	.38	.57
June, 1921	2.17	43.00	14.50	1.95	1.25	2.50	58.30	3.33	2.20	2.10	3.38	2.55	2.40	.1156	.80	.38	.58
Average	**$2.17**	**$46.25**	**$15.00**	**$1.95**	**$1.25**	**$2.50**	**$61.60**	**$3.33**	**$2.15**	**$2.10**	**$3.35**	**$2.55**	**$2.25**	**$0 25**	**$0.73**	**$0.38**	**$0.57**
April, 1922	$1.97	$44.00	$16.25	$1.75	$1.00	$1.75	$47.30	$2.48	$1.50	$1.50	$2.58	$1.75	$2.48	.....	$0.83	$0.38	$0.43
May, 1922	1.97	43.00	17.00	1.75	1.00	1.75	47.30	2.58	1.60	1.60	2.68	2.00	2.58	.....	.91	.38	.42
June, 1922	1.97	43.00	20.00	1.75	1.00	1.75	49.30	2.58	1.60	1.60	2.68	2.00	2.58	.....	.91	.38	.43
Average	**$1.97**	**$43.33**	**$17.75**	**$1.75**	**$1.00**	**$1.75**	**$47.97**	**$2.55**	**$1.57**	**$1.57**	**$2.65**	**$1.92**	**$2.55**	.....	**$0.88**	**$0.38**	**$0.43**
General average...	**$1.69**	**$40.11**	**$11.25**	**$1.44**	**$0.81**	**$1.56**	**$44.59**	**$3.10**	**$2.38**	**$2.26**	**$2.81**	**$2.16**	**$3.05**	**$0.1045**	**$0.97**	**$0.23**	**$0.34**
Dec. 14, 1922	**$2.20**	**$54.00**	**$15.50**	**$1.75**	**$1.00**	**$2.00**	**$54.30**	**$3.14**	**$2.00**	**$2.00**	**$3.54**	**$2.50**	**$3.14**	.....	**$0.90**	**$0.34**	**$0.47**

December Review Of Volume and Prices

On these three pages the totals of contracts awarded on important construction projects are given for the entire year 1922, as well as for the month of December Comparisons are also made with 1913 and the last three years. Prevailing labor rates and industrial conditions in the various cities reporting to *Engineering News-Record* are recorded, together with current prices on construction materials.

Contracts Let Increased Over 26 Per Cent in Year

The value of contracts let in the United States and Canada on important engineering construction projects, as announced in the four December issues of *Engineering News-Record*, aggregated $123,143,000, compared with $134,697,000, reported in the five issues of November. This represents an average weekly rate of $30,785,750 for December as against $26,939,400 during November. Lettings in the United States for the entire year reached $1,556,550,000, an increase of 26 per cent over 1921 and 2 per cent under the 1920 total.

Minimum costs observed in Construction News, on each class of construction, are as follows: Waterworks, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings $150,000.

The December decline in total value of contracts let, represents a purely seasonal condition, pointing to a continuance of the prolonged building boom.

The heaviest falling off was noted in bridge construction, which declined over 79 per cent, since November. Sewer construction dropped over 55 per cent and streets and roads nearly 13 per cent, during the month.

An increase of 6 per cent was realized, however, in industrial building during December, with substantial gains in 000,000 and $250,000,000. Likewise the E. N.-R. total of $1,556,550,000 for 1922, combined with the smaller engineering construction awards not covered in these pages, would amount to over $3,000,000,000 for the year, thereby exceeding all records since the 1920 peak.

TABLE III—LAST THREE YEARS CONTRACTS COMPARED WITH 1913

Classification	1913	1920	1921	1922
Waterworks	$24,373,000	$30,772,098	$40,602,948	$36,220,000
Sewers	26,905,000	36,066,577	39,385,042	43,584,000
Bridges	23,290,000	35,213,881	27,330,677	43,427,000
Streets, roads	48,471,000	265,423,491	315,351,427	334,694,000
Excavation, drainage and irrigation		16,218,664	19,180,500	19,551,000
Industrial	49,104,000	482,200,884	114,256,054	198,141,000
Buildings	148,687,000	581,324,693	568,261,252	750,762,000
Federal Government	39,405,000	35,281,531	26,607,391	43,552,000
Miscellaneous	135,303,000	99,501,217	60,395,674	86,569,000
Total	$495,542,000	$1,582,013,036	$1,231,370,965	$1,556,550,000

Engineering News-Record Construction Cost Index Number

January, 1923	**191.70**
December, 1922	192.60
January, 1922	168.72
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number dropped nearly one point since last month, due to decline in cement quotations. Steel holds at $2.00 per 100 lb., Pittsburgh mill. The average rate for common labor is still 47c. Thus, general construction cost is 13.6 per cent higher than one year ago and 30 per cent under the peak; it is 91.7 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly

December, 1922 (*4 issues of E. N.-R.*)	**111**
November, 1922 (*5 issues of E. N.-R.*)	122
December, 1921 (*5 issues of E. N.-R.*)	118
1913	100

Yearly

1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 111 for the month of December, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 111 for December, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

TABLE I—VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN DECEMBER, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks	.....	$278,000	$761,000	$365,000	$209,000	$41,000	$181,000	$1,835,000
Sewers	.....	789,000	389,000	394,000	238,000	286,000	285,000	2,381,000
Bridges	.....	214,000	406,000	32,000	194,000	494,000	.....	1,340,000
Excavation, drainage and irrigation	.....	.....	270,000	75,000	220,000	304,000	.....	869,000
Streets and roads	$260,000	982,000	7,647,000	2,001,000	5,969,000	1,237,000	.....	18,096,000
Industrial works	1,175,000	5,358,000	554,000	5,356,000	5,128,000	455,000	1,150,000	19,176,000
Buildings	8,640,000	20,726,000	3,410,000	23,708,000	6,179,000	5,111,000	1,832,000	69,606,000
Federal Government	.....	804,000	303,000	59,000	1,155,000	.....	.....	2,321,000
Miscellaneous	218,000	3,898,000	188,000	2,209,000	71,000	513,000	422,000	17,519,000
Total	$10,293,000	$33,049,000	$13,928,000	$34,199,000	$19,363,000	$8,441,000	$3,870,000	$123,143,000

TABLE II—VALUE OF CONTRACTS LET IN THE UNITED STATES, JAN. 1, 1922 TO JAN. 1, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks	$2,770,000	$7,435,000	$3,587,000	$6,512,000	$11,340,000	$4,576,000	$36,220,000
Sewers	653,000	10,608,000	4,125,000	18,286,000	6,785,000	3,127,000	43,584,000
Bridges	2,341,000	16,539,000	8,536,000	5,205,000	7,052,000	3,804,000	43,427,000
Excavation, drainage and irrigation	118,000	918,000	9,093,000	1,813,000	4,477,000	3,132,000	19,551,000
Streets and roads	10,573,000	72,961,000	73,944,000	76,136,000	63,614,000	37,466,000	334,694,000
Industrial works	33,744,000	59,587,000	21,767,000	57,365,000	15,753,000	9,925,000	198,141,000
Buildings	65,298,000	281,521,000	44,366,000	225,628,000	72,913,000	61,036,000	750,762,000
Federal Government	2,686,000	16,313,000	8,105,000	3,380,000	4,052,000	9,016,000	43,552,000
Miscellaneous	5,359,000	49,968,000	4,626,000	10,148,000	7,553,000	8,915,000	86,569,000
Total	$123,542,000	$515,850,000	$178,149,000	$404,473,000	$193,539,000	$140,997,000	$1,556,550,000

World Economic Situation For 1923

By Secretary of Commerce Herbert Hoover

The following summary of the world's economic situation and prospects is based upon the special investigation of representatives of the United States Department of Commerce, in each foreign country:

In the large view the world has made distinct economic progress during the past year and the conditions are very favorable to continued progress during 1923. There are in exception three or four states in Europe which give continued anxiety, but these exceptions should not obscure the profound forces of progress elsewhere over the whole world. In the main even in these areas of uncertainty the difficulties are to a large degree fiscal and political rather than commercial and industrial.

During the year the world generally has gained in social stability: Bolshevism has greatly diminished and even in Russia has been replaced by a mixture of socialism and individualism; at least active war has ceased for the first time since 1914; famine and distress have diminished to much less numbers this winter than at any time since the great war began; production has increased greatly during the past year; unemployment is less in world totals than at any time since the armistice; international commerce is increasing; the world is now pretty generally purchasing its commodities by the normal exchange of services and goods, a fact which in itself marks an enormous step in recovery from the strained movements of credit and gold which followed the war.

In our country unemployment has ceased to be a problem and we are indeed upon an economic level of comparatively great comfort in every direction except for the lag of recovery in some branches of agriculture. Even in this field there has been a distinct improvement in prices in the past twelve

Labor Rates and Conditions Throughout the Country

A shortage of freight cars proves to be the most serious of the several impediments, now confronting the industries of the country. Production records, with an adequate supply of freight cars, would soon approach the peak levels of 1919-1920, despite seasonal declines. The car situation, however, is due to a combination of circumstances, involving the following factors: (1) Coal miners' strike during the summer; (2) Tremendous volume of freight piled up; (3) Lack of cars to haul materials to build new cars or repair old ones; (4) Claim on the part of railroads that their industry is unprofitable, also that insufficient capital is being attracted to permit of investments in unusual expansion of freight equipment.

Labor shortage has handicapped some industries and that, combined with restricted immigration, has seriously hampered industrial activities, causing wages to trend upward.

Construction activities have only slackened to a degree consistent with normal seasonal slow-down. The building season, however, in the face of an unsatisfied housing demand, has been extended much further into the winter months than was expected; and promises to continue in this direction, weather permitting.

Local industrial conditions as reported by *Engineering News-Record* correspondents are as follows:

Atlanta—Weather mild; building continues active with many new projects under way.

Boston—Plenty of building trades mechanics. Common labor rate 50@60c. as against 50@55c. per hr. one month ago.

Cincinnati—Carpenters on strike. Brick layers reduced to $1.25, from $1.35 per hr. All classes of building labor plentiful.

Dallas—Enough hodcarriers and common laborers; limited supply of other crafts.

Denver—Building trades 100 per cent employed. Construction work continuing without interruption.

Detroit—Seasonal slackening of building construction causing larger supply of workmen in all trades. No great surplus evident yet.

Kansas City—Few carpenters available; other trades plentiful. Better grade of common laborers scarce; wage scale reduced from 40@50c. to the present rate of 30@50c. per hr.

Montreal—Labor, all classes, plentiful. Common laborers receive 30c. as compared with 30@35c. per hr., one month ago.

New York—Conditions point to the continuance of the 1921 wage scale. Scarcity of skilled building trades mechanics; plenty of common laborers. Wage rate for pick and shovel men, 45@50c. per hr., at excavating work; 60c. per hr. on buildings.

Pittsburgh—No labor shortage in construction industry. Range of common labor rates, 40@60c. per hr.

St. Louis—Bricklayers rate, $1.25; being paid $1.37½ per hr. because of extreme shortage. Carpenters rate, $1.10; plan to demand $1.25 per hr. after May 1, 1923. Few being paid above scale at the present time. Hoisting engineers will ask increase of 12½c. per hr. on May 1; similar demand to be put forward by structural iron workers, March 1. Plasterers granted increase of 12½c., effective Dec. 1, 1922; helpers receive same wage advance Jan. 1, 1923. General move for higher wage rates in spring, anticipated.

San Francisco—Bricklayers awarded advance of 12½c.; hodcarriers, 6¼c. and common laborers, 2½@6¼c. per hr., effective Jan. 2, 1923. Plenty of work for all trades.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.....	$0.65	$0.30@.35
Baltimore	1.25	.80	.87½@.90	.60@.75	$0.75	1.00	.35@.40
Birmingham	1.00	.75	.50@1.00	.15@.25	.....	1.00	.20@.25
Boston	1.25	1.00	90@1.00	.75@.80	1.00	1.00	+.50@.60
Cincinnati	—1.25	.95	.95	.72½	.....	.95	.35@.40
Chicago	1.10	1.00	1.10	.....	1.10	1.05	.72½
Cleveland	1.25	1.10	1.10	.75	.91	1.10	.75
Dallas	1.37½	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03¼	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.12½	1.00	+1.00@1.25	.80	1.00	—1.00	.30@.50
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	56¼@.62½
Minneapolis	1.00	.80	.80	.65	.....	.80	.35@.50
Montreal	.90	.65	.50	.35	.50	.65	.30
New Orleans	1.00	.85	.90	.65	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	.45@.60
Pittsburgh	1.30	1.12½	1.00	.90	1.00	1.00	.40@60
St. Louis	1.25	1.10	1.12½	.85	1.12	1.12½	.30@.45
San Francisco	+1.25	1.00	1.00	+.81¼	1.00	1.12½	+.50@.56¼
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.25	.90@1.00	.90@1.00	.75@.90	1.00	.90@1.00	.35@.45

months and its troubles are mostly due to over production in some lines. Our manufacturing industries are engaged well up to the available labor; industrial production has enormously increased over last year; real wages and savings are at a high level. Our transportation and housing show great gains in construction, though we are yet behind in these equipments. Both our exports and our imports are again increasing after the great depression and are today far above prewar levels.

Outside of Europe the whole world has shaken itself free from the great afterwar slump. The economic wounds of Asia, Africa, Latin America, and Australia from the war were more the sympathetic reaction from slump in the combatant states than direct injury. Their production and commerce has recovered to levels above prewar. The enforced isolation of many areas in Latin America and Asia during the war has strengthened their economic fibre by increased variety of production and has contributed vitally to their effective recovery.

In Europe, England together with the old neutral nations are making steady progress in production and diminishing unemployment. Their trade and commerce are improving; their governmental finances are growing stronger; their currencies that are not already on a gold basis are steadily approaching par; and their exchanges are more stable. The combatant states on the Continent are slower in recovery. Even these nations, including Russia, have shown progress all along the line in commercial, industrial, and agricultural fields although the harvests suffered in some spots. Some of these nations such as Italy, Belgium, the Baltic States, Poland, Czechoslovakia, and Hungary show increasing political and social stability and improvement in their Governmental finances. In Germany and some minor states in southeastern Europe governmental finance and political difficulties threaten to overwhelm the commercial and industrial recuperation already made.

The continued maintenance of armies on a greater than pre-war basis in the old Allied states maintains political uncertainty, lowers productivity, and retards the balancing of budgets with consequent cessation of direct or indirect inflation. Disarmament and the constructive settlement of German reparations and the economic relations of states in southeastern Europe are the outstanding problems of Europe, and their adjustment to some degree will affect the progress of the rest of the world. The more general realization during the past year of the growing menace of these situations and the fundamentals that underlie their solution is in itself some step toward progress. Their solution would mark the end of the most acutely destructive forces in the economic life of the world which still survive the war.

Economic forecast cannot amount to more than a review of tendencies and a hazard in the future. The odds are favorable for 1923; the world begins the year with greater economic strength than a year ago; production and trade are upon a larger and more substantial basis, with the single exception of the sore spot in Central Europe.

The healing force of business and commerce has gained substantial ascendency over destructive political and social forces. There is ample reason why there should be continued progress during the next twelve months.

Tax-Exempt Securities Amendment Opposed

Washington Correspondence

Such opposition was developed in the House of Representatives against the proposed constitutional amendment aimed at tax-exempt securities that the consideration of the bill has been put over until late in January. Many are of the opinion that no further effort will be made to call it up. Even if it is brought to a vote later in the session, it is very doubtful if the proponents of the measure can muster the necessary two-thirds majority required to adopt a constitutional amendment.

The principal arguments advanced for the amendment are that tax-free securities shift taxation from the rich to the poor; that they divert capital from productive enterprises; create unrest because of the avenue afforded certain citizens to escape taxation, and that they encourage extravagance in municipal expenditures.

Opponents of the measure contended that the national government should not have the power of imposing taxes upon the bond issues of the cities, towns and counties. To do so, they believe, simply would transfer the burden to the people who issue the bonds and who in the course of time, must redeem them. It was contended that it would paralyze the farm loan system an the great program of internal development, including highways, reclamation projects and the building of schools. Much of the influence behind the amendment, it was stated on the floor of the House, comes from those who already own large blocks of tax-exempt bonds, since the ratification of the amendment would increase enormously the market value of the tax-exempt securities already issued.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig-Iron—Market quiet following recent wave of buying; prices show average decline of $2 per ton since last month. Higher quotations, however, considered unavoidable owing to recent stiffening of fuel costs.

Railway Supplies—Minimum on light rails $40@$42 per ton at mill; $10 higher than year ago. Slight rise in red oak ties in Middle West. Track bolts, 10c. per 100 lb. cheaper at mill.

Pipe—Cast-iron pipe, 6-in., $43 as against $43@$43.50 per ton, last month, at Birmingham mill. Decline of $2 reported in San Francisco. Prices lower on 4 and 6-in. in Chicago and on 4-in. in New York. Sharp drop on clay-drain tile in St. Louis. Slight declines in sewer pipe in St. Louis and Boston. Wrought steel and iron pipe prices firm.

Road and Paving Materials—Road oil prices unchanged; demand light. Asphalt up 50c. per ton in Boston; declined sharply in Seattle during month. Granite paving blocks advanced $2 per M. in Philadelphia. General tendency of flagging and curbing prices upward, in New York and Middle West. Wood blocks, 3½ in., $2.26 as against $2.32 in Boston and $2.46, compared with $2.48 per sq.yd. in Philadelphia.

Sand, Gravel and Crushed Stone—Sand-prices firm throughout country. Gravel, at minimum of $2.25 per cu.yd. in Detroit as against $2@$2.25, one month ago; due to increased handling costs in cold weather and also higher labor. Crushed stone up 5c. per cu.yd. in Boston; declines reported in Atlanta, Cincinnati and St. Louis.

Lime—Hydrated finishing, down $10; common hydrated, $1 per ton in St. Louis, during month. Minneapolis also reports drop of $1 per ton in common hydrated. Boston quotes advance of $1.50 in hydrated finishing; $1 per ton in hydrated common and 15c. per bbl. in lump finishing.

Cement—Reduction of 15c. per bbl. at Buffington, Ind., mills; 10c., at Universal, Pa. and Steelton, Minn. Mill reduction reflected in similar drop in quotations, f.o.b., fourteen Middle Western cities.

Structural Steel—Tendency higher in finished steel, following advances in coke and scrap prices. Plates, shapes and bars firm at $2 per 100 lb., Pittsburgh, with few attempts at price shading. Heavy buying of ship and tank plates and car materials. Wire products up $1@$2 per ton at mill.

Brick and Hollow Tile—Common brick, $20 as against $15@$15.50 per M., alongside dock, New York, one month ago. No shortage; demand unusual for this season of the year. Dallas also reports advance of $1 per M. Brick down, $2 in Boston; $1.50, in Atlanta and 50c. per M. in Detroit. Few changes in hollow tile. Slight advances in Atlanta and Montreal; decline in Boston.

Lumber—Car shortage main factor in holding prices up; scarcity, however, being slowly relieved. With better deliveries, prices are expected to lower. Yellow pine structural timbers, base sizes, up $10 in Boston and $2 per M. ft. b.m. in Detroit; down, $1.50 in St. Louis, $2 in Minneapolis and $7.50 in Cincinnati, during month. Fir high along Atlantic Seaboard and in Middle West. Hemlock down; spruce advanced.

Scrap—Market stronger; demand for first quarter improved. Prices firm in New York, Chicago and St. Louis.

Explosives—Price tendency upward; 40@60 per cent gelatin dynamite, higher in Cincinnati, 40 per cent, up in Philadelphia.

Linseed Oil—Raw oil 93c. as against 90c. per gal., one month ago, in New York; Chicago, 98c., compared with 95c. Dallas advanced 2c. and Atlanta dropped 3c. per gal. in week.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$27.55	$22.50
Northern Basic	*28.27*	22.02
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*29.27*	23.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*33.44*	28.50
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*23.00*	18.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*28.76*	22.26
Virginia No. 2 (silicon 2.25 @ 2.75)	*33.17*	28.74
Basic	*27.50*	20.75
Gray Forge	*28.14*	22.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	*28.00*	21.70
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*28.51*	24.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*25.00*	22.46
Basic	*24.25*	20.96
Bessemer	*27.50*	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	.....	$43.00	43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb	40.00	31@32	2.00*	43.00	43.00
Light rails, 12 to 14 lb	42.00	31@32	2.00*	43.00	43.00
Light rails, 25 to 45 lb	42.00	31@32	2.00*	43.00	43.00
Rerolled Rails	28@30	.....	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.40	$1.55
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.84	1.17
San Francisco, Empty Cell Creosoted, Douglas Fir	1.60	2.25
St. Louis, White Oak	1.30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.15	1.40
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.75	$2.25	$2.55	*$3.60*	$4.45	$3.29
Track bolts	3.75@4.50	3.25@3.50	3.65	*4.70*	5.45	4.29
Standard section angle bars	2.75	2.40	2.40	*3.45*	4.10	2.94

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	66	54½	¼ to 1¼	34	19

LAP WELD

2	59	47½	2	29	15
2½ to 6	63	51½	2½ to 4	32½	19
7 to 8	60	47½	4½ to 6	32½	19
9 to 12	59	46½	7 to 12	30	17

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	64	53½	¼ to 1¼	34	20
2 to 3	65	54½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	57	46½	2	30	17
2½ to 4	61	50½	2½ to 4	33	21
4½ to 6	60	49½	4½ to 6	32	20
7 to 8	56	43½	7 to 8	25	13
9 to 12	50	37½	9 to 12	20	8

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	57%	62½%	57%
2½ to 6 in. lap welded	54%	59½%	54%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	44%	48½%	44%
2½ to 6 in. lap welded	41%	45½%	41%

Malleable fittings, Class B and C, from New York stock sell at list less 10% Cast iron, standard sizes, *52-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	*$47.00*	*$54.50*	$50.30	*$55.20*	$53.10	*$56.00*
6 in. and over	*43.00*	**59.00**	47.30@48.30	*51.20*	49.10	*52.00*

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	*$40.00*	$50.00	.....	$55.00
4	55.00	50.00	*40.00*	60.00	$76.50	65.00
5	80.00	80.00	*75.00*	80.00	97.75	84.00
6	105.00	105.00	*75.00*	100.00	127.50	110.00
8	170.00	175.00	*165.00*	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.105	.....	$0.0875	$0.12	$0.12	.....
4	.14	105	$0.10		.12	.15	$.175
5	.20	.1575	.125		.18	.18	.20
6	.20	.1575	.150	*.1225*	.18	.21	.2625
8	.34	.245	.225	.2000	.28	.30	.435
10	.51	.3675	.2925	.2800	.42	.42	.64
12	.65	.4725	.3825	.36	.54	.54	.82
15	1.03†	.63	.5625	.52	.72	.90	1.18
18	1.50†	.875	.765	.68	1.00	1.32	1.65
20	1.80†	1.05	1.0125	.92	1.20	.....	.....
22	2.40†	1.40	1.2375	.....	1.60	.....	2.10
24	2.70†	1.575	1.4625	1.20	1.80	2.16	2.73
27	4.50‡	2.795	....	2.45†	3.75†	3.00	.....
30	5.00†	3.096	....	3.00†	4.75†	3.60	.....
33	6.50‡	4.14	....	3.55†	5.50†	.....	.....
36	7.50†	4.715	....	3.96†	6.00†	.....	.....

	3	5	8	12	24	36
Boston	*$0.12*	*$0.185*	$0.29	*$0.55*	*$1.845*†	*$5.535*†
Minneapolis	.....	.....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.325	.65†	2.34†	.....
Los Angeles	.....	.....	.....	.....	.....	.....
New Orleans	.1120*	.168*	.28	.476	1.82†	.....
Cincinnati	.111*	.1665	.259	.4995	1.665	4.407†
Atlanta	.108*	.162*	.27	.459	1.75†	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.102	.153	.238	.459	1.98†	6.15†
Baltimore	.....	.....	.....	.....	.....	.....
Kansas City, Mo	.135	.19	.30	.54	2.16	.....
Philadelphia	12	.18	.28	.54	1.80†	4.10†

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt (at terminal)	$0.06	$0.05½
New York, 65% asphalt (at terminal)	.06	.05½
New York, binder (at terminal)	.06½	.07½
New York, flux (at terminal)	.06½	.06
New York, liquid asphalt (at terminal)	.07	.06½
St. Louis, 50@60% asphalt	.04½	.01½*
Chicago, 40–50% asphalt	.05½	.05
Chicago, 60–70% asphalt	.05½	.05½
Dallas, 45% asphalt	.040	.10
Dallas, 55% asphalt	.048	.13
Dallas, binder	.053	.15
San Francisco, binder, per ton	9.50†	15.00†

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$20.00	$16.00
Boston (*Mexican*)	19.50	16.00
Chicago (*Stanolind*)	26.00	22.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00*	11.00*
Dallas, (*Texas*)	*26.00*	*18.00*
Seattle "*D*" *grade* (*California*)	23.75	13.00†
Denver (*California*)	40.00	
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	*28.25*	*21.90*
St. Louis (*Mexican*)	25.00	21.00
Baltimore (*Mexican*)		
Los Angeles, *at factory, Bakersfield* (*California*)		
Montreal (*Mexican*)	28.00	21.00
Atlanta (*Mexican*)	22.00	16.50
Detroit (*Mexican*)	23.68	18.95
Cincinnati (*Mexican*)	22.50	19.50
Maurer, N. J. (*Trinidad and Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	18.00	15.50
Philadelphia (*Mexican*)	20.00	16.00
Kansas City, *petroleum*	28.83	22.83

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York	5-in. granite, 30 blocks per sq.yd.	$4.45 per sq.yd.
Chicago	About 4x8x4 dressed	3.35 sq.yd.
	About 4x8x4 common	3.10 sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	2.00 per sq.yd.
Atlanta	Granite	2.10 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	
Montreal	Granite	100.00 per M
New Orleans	Granite, 4 x½8 x 4	3.25 sq.yd.
Cincinnati	Granite	1.35 per M.
St. Louis	4x8x4 dressed	3.10 sq.yd.
	4x8x4 common	2.90 sq.yd.
Kansas City	Granite	3.95 sq.yd.
Philadelphia	Granite	130.00 per M.

FLAGGING—

New York	Bronx, 5 ft.	$0.50 sq.ft.
	Manhattan, 4 ft.	.35@.40 sq.ft.
	Queens, 5 ft.	.35@.40 sq.ft.
	6x20-in. cross-walk	1.00 lin.ft.
Chicago	18 in. wide	.99 lin.ft.

CURBING—Bluestone per lineal foot, delivered in New York, costs $2.40@2.75 for 5x16 in.; $3.50@4.00 for 5x18 in. 5x18 in., *$1.40* per lin.ft. delivered in St. Louis. 6x18 in., Chicago, $2 per lin ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.21
New York (*delivered*)	3½	16	2.30
New York (*delivered*)	4	16	2.77
Boston	3½	16	*2.26*
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.00
St. Louis	4	16	2.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2.30
New Orleans	3	16	*1.75*
New Orleans	3½	16	1.95
New Orleans	4	16	2.25
Dallas	4	18	3.90
Baltimore	3½	16	
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.35
Kansas City	4	16	3.25
Philadelphia	3½	16	*2.46*

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$2.00	$1.75	$2.00	$1.75	$1.00	$1.00
Denver	1.90	2.50	1.90	2.50	1.30	1.10
Chicago	2.25	2.00	2.25	2.00	2.25	2.00
St. Louis, *per ton*	1.45	1.25	1.50	1.30	1.45	1.20
Seattle	1.00	1.50	1.00	1.50	1.00	1.50
Dallas	*2.25*	2.00	*2.25*	2.00	*1.87½*	2.00
Minneapolis	1.75*	1.50	1.75*	1.50	1.00	0.50*
Cincinnati	*1.25*	1.00	1.25	1.50	1.15	1.50
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	1.40	2.65	1.40	2.65	1.10	2.00
New Orleans	2.85	2.08½	2.85	2.08½	1.35	1.35
Los Angeles, per ton		1.35		1.35		1.20
Atlanta, per ton	1.75	1.85	1.75	1.85	1.32	1.25
Detroit	2.25	2.00	2.25	2.00	2.00	2.00
Baltimore, per ton		1.40		1.60		2.00
Montreal, per ton	1.25	1.25	1.50	1.50	1.25	1.25
Birmingham, per ton (Crushed slag used instead of gravel)					1.25	1.28
Philadelphia	1.70	1.50	1.75	1.57	1.65	1.80
Kansas City, per ton	2.00†	....	2.00†	....	0.66*	....

New York—Grit, $1.75 per cu. yd.
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65	$1.80@1.90	$1.75	$1.80@1.90
Chicago	2.25	1.60	2.25	1.60
St. Louis *delivered*	*2.00*	1.65*	*2.10*	1.65*
Dallas	1.65	2.93	1.65	2.93
San Francisco	2.15	2.25	2.15	2.25
Boston, *delivered*	1.70	3.00*	1.70	3.00*
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City	2.40	2.75	2.40	2.75
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2.00*	2.00*
Cincinnati *delivered*	*1.80**	2.37½	*1.80**	2.08
Los Angeles		1.60*		1.70*
Detroit	1.90@2*	1.90*	1.90@2*	1.90*
Baltimore		1.75*		1.65*
Montreal	1.80*	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Philadelphia	1.75*	1.70	1.60*	1.55
Pittsburgh	2.85	....	2.85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn.	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa	1.00	1.00	2.00	0.90
Birmingham, Ala.	*1.00*	*1.00*	*1.00*	*1.00*
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$16.80@$17.10	$13.10	$3.63½*	$2.75@$3.13½*
Chicago	18.00	18.00	1.50†	1.40†
St. Louis	*22.20*	*19.00*	18.75‡	18.00‡
Boston	18.50	14.00	3.90*	3.00*
Dallas	22.50		....	2.50†
Cincinnati	15.80	13.30	....	10.75‡
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	*21.00* (white)	*1.55*†	1.40†
Denver	24.00		....	2.70†
Detroit	19.50	17.50	....	18.25‡
Seattle *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	.....	.....	....	.....
Baltimore	.....	.....	.....	.....
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	23.00	13.00	2.25†	1.85†
New Orleans	.....	17.25	2.40†	.....
Philadelphia	15.50	14.50	13.00‡	12.00‡
Kansas City	25.60	24.00	2.40†	2.40†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.55, Sheboygan $1.45. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	*1.50*	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.72	1.93
Boston (Rosendale) per bag	....	0.85@0.95
St. Louis (Carney)	*1.75*	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Dec. 7	One Month Ago	One Year Ago
New York, del. by truck	$2.60@2.70	$2.60	$2.20@2.30
New York, alongside dock to dealers	2.30	2.30	2.00
Jersey City	2.48	2.48	2.12
Boston	2.85	2.85	2.52
Chicago	*2.05*	2.20	1.97
Pittsburgh	*2.14*	2.24	2.02
Cleveland	*2.36*	2.46	2.26
Detroit	*2.33*	2.47	2.17
Indianapolis	*2.26*	2.41	2.21
Toledo	*2.33*	2.48	2.20
Milwaukee	*2.22*	2.37	2.18
Duluth	*2.04*	2.14	1.95
Peoria	*2.26*	2.39	2.13
Cedar Rapids	*2.33*	2.45	2.26
Davenport	*2.28*	2.43	2.21
St. Louis	2.35	2.35	2.20
San Francisco	2.71	2.71	2.84
New Orleans	3.30	3.30	3.20
Minneapolis	*2.22*	2.39	2.24
Denver	2.85	2.85	3.10
Seattle	2.90	2.90	3.10
Dallas	2.25	2.25	2.55
Atlanta	2.54	2.54	2.55
Cincinnati	*2.39*	2.51	2.35
Los Angeles	....		3.31
Baltimore	....	2.90	2.50
Birmingham	2.40	2.40	2.27
Kansas City	2.45	2.45	2.45
Montreal	2.88	2.88	3.10
Philadelphia	2.51	2.51	2.23
St. Paul	2.29	2.39	2.24

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind.	*$1.80*	Mason City, Ia.	$2.05
Universal, Pa.	*1.90*	La Salle, Ill.	2.05
Steelton, Minn.	*1.85*	Hudson, N. Y.	2.20
Fordwick, Va.	2.20	Leeds, Ala.	2.20
Mitchell, Ind.	2.05	Hannibal, Mo.	2.10
Iola, Kan.	2.10	Lehigh Valley District	2.10

TRIANGLE MESH—Price per 100 sq. ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq. ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
033	22	$0.85	$0.95	$0.92	$1.172	$1.03
049	28	1.08	1.23	1.18	1.488	1.34
068	35	1.31	1.48	1.43	1.835	1.64
093	45	1.69	1.91	1.84	2.345	2.10
126	57	2.08	2.35	2.27	2.917	2.60
153	68	2.48	2.81	2.71	3.468	.....
180	78	2.85	3.22	3.12	4.08	.....
245	103	3.76	4.25	4.11	5.253	.....
287	119	4.34	4.90	4.74	6.079	5.43
336	138	5.04	5.69	5.51	7.458	.....
395	160	5.84	6.60	6.38	8.16	.....
		PAVING				
036P	17	$0.65	$0.72	$0.71	$0.897	.....
053P	24	.91	1.02	.99	1.284	.....
072P	31	1.15	1.29	1.26	1.601	.....
097P	40	1.48	1.67	1.62	2.06	.....
049R	24	.91	1.02	.99	1.264	.....
067R	31	1.15	1.29	1.26	1.601	.....
089R	40	1.48	1.67	1.62	2.06	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22.00	*$20.39*	$20.22	$20.78	$25.50
26 "	2.5	22.00	*21.93*	21.64	21.43	27.58
25 "	3.0	22.00	*24.45*	24.28	.....	30.71
24 "	3.4	24.00	*26.33*	26.10	24.28	33.16
22 "	4.33	27.00	*31.06*	*30.77*	.....	35.10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¼ and larger	$2.00	$2.35	$3.04	$2.92	2.75	*$3.15*	$3.35
¼	2.05	2.45	3.09	2.97	2.80	*3.20*	3.40
¼	2.10	2.55	3.14	3.02	2.85	*3.25*	3.45
¼	2.25	2.60	3.19	3.17	2.95	*3.40*	3.60
¼	2.50	2.65	3.54	3.42	3.20	*3.65*	*1.85*

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¼ and larger	$2.10	$2.45	$3.50	¼	$2.35	$2.75	$3.95
¼ in.	2.15	2.50	3.75	¼	2.60	3.00	4.20
¼	2.20	2.55	3.80		.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current*	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$23.50	$18.00@18.55	$17.40@18.40	$42.00†	$50.00†
New York (at dock)	20.00	15@15.50	14@15	.....	.....
Chicago	11.00	11.00	11.00	34.00	42.00
St. Louis, salmon	15.00	15.00	16.00	35.50	40.00
Denver, salmon	12.00	12.00	14.00	.....	.....
Dallas	10.90	9.90	12.65	no market	
San Francisco	15.50	15.50	15.50	.....	.....
Los Angeles (del.)	.....	.....	15.50	(not used)	
Boston (del.)	*20.00*	22.00	17.00	70.00	70.00
Minneapolis (del.)	18@19	18@19	15.00	.....	43.00
Kansas City	14.50	14.50	14.50	.....	.....
Seattle	14.00	14.00	14.00	44.00	.....
Cincinnati	17.00	17.00	19.00	42.00	42.00
Montreal	16.00	16.00	16.00	70.00	75.00
Detroit (del.)	*16.50@17.00*	17.00	15.00	36.50	39.50@41
Baltimore (del.)	.....	20.00	20.00	.....	.....
Atlanta	*10.00*	10.00	9.00	39.00	.....
New Orleans	15.75	15.75	14.00	.....	.....
Birmingham	12.50	12.50	11.50	.....	.....
Philadelphia	20@28	20@28	16.00	40.00	48.00
Pittsburgh (del.)	16.00	16.00	.....	.....	.....
Cleveland	16.00	16.00	.....	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0.123	$0.1112	$0.0674	$0.12	$0.088	$0.108	.....
6x12x12	.1844	.1667	.0926	.....	.114	.156	.....
8x12x12	.2305	.2084	.1263	.1875	.16	.244	$0.2147
10x12x12	.....	.....	.1621	.....	.18	.....	.2653
12x12x12	.....	.....	.1853	.....	.22	.....	.3448

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	*$0.1015*	*$0.1904*	.....
Minneapolis (f.o.b. cars)	0.0696	.115	$0.204
Minneapolis (delivered)	.0796	.13065	.229
Cincinnati	.0859	.1611	....
Kansas City	.083	.105	....
Denver	.065	.123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles factory	....	....	....
New Orleans	.12	.23	.36
Detroit (delivered)	.09	.175	.26
Montreal	.115	.225	.30
Baltimore	.....	.....	.....
Atlanta	.0859	.1615	.....
Dallas	.115	....	.....
Birmingham	.11	.18	.....
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.08	.164	.....

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh, Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.00	$2.40	$3.14	$4.40	$3.00	$3.02½	$3.25
Channel, 3 to 15 in.	2.00	2.40	3.14	4.40	3.00	3.02½	3.25
Angles, 3 to 6 in., ¼ in. thick	2.00	2.40	3.14	4.40	3.00	3.02½	3.25
Tees, 3 in. and larger	2.00	2.40	3.14	4.40	3.05	3.02½	3.25
Plates	2.00	2.40	3.14	4.50	3.00	3.02½	*3.35*

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York, Current	New York, One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$3.00	$3.85	$3.50	$3.75	$3.85	$4.75	*$5.25*

CONE HEAD BOILER

½ in. and larger	$3.10	3.95	3.60	3.85	3.95	4.85	*5.40*
⅝ and ¾	3.25	4.11	3.76	4.00	3.95	5.00	*5.55*
⅞ and 1	3.50	4.35	4.00	4.25	3.95	5.25	*5.80*

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.80	$3.45	$4.00	$4.40	*$3.11*	$4.95
Cut	3.35	5.50	5.65	*6.90*	3.26	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply l.c.l.
No. 1 grade	$2.10	$2.55	$3.00	$1.90	$2.35	$2.80
No. 2 grade	1.85	2.15	2.55	1.70	2.00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq. ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.
Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq. ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.90

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq. ft.) per roll of 432 sq. ft.	$2.00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1.65
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.50	4.10	$4.00	$4.35	$4.19
No. 12	2.60	4.15	4.05	4.40	4.24
No. 14	2.70	4.20	4.10	4.45	4.29
No. 16	2.90	4.30	4.20	4.55	4.39
Black					
*Nos. 18 and 20	3.20	4.65	4.70	5.70	*4.30*
*Nos. 22 and 24	3.25	4.70	4.70	5.75	*4.35*
*No. 26	3.30	4.75	4.75	5.80	*4.40*
*No. 28	3.35	4.80	4.85	5.90	*4.50*
Galvanized					
No. 10	3.35	4.85	4.85	...	*4.50*
No. 12	3.45	4.95	4.95	5.85	*4.60*
No. 14	3.45	4.95	4.95	5.85	*4.60*
Nos. 17 to 21	3.75	5.10	....	6.15	*4.90*
Nos. 22 and 24	3.90	5.40	5.40	6.30	*5.05*
*Nos. 25 and 26	4.05	5.55	5.55	6.45	*5.20*
*No. 28	4.35	5.85	5.90	6.75	*5.50*

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrel (5 bbl. lots)	$0.93	$0.72	$0.98	$0.74

WHITE AND RED LEAD—Base price in cents per pound:

	Red — Current		Red — 1 Year Ago		White — Current	White — Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	13 50	15 00	12 25	13 75	13 50	12 25
25 and 50-lb. kegs	13 75	15 25	12 50	14 00	13 75	12 50
12½-lb. keg	14 00	15 50	12 75	14 25	14 00	12 75
5-lb. cans	16 50	18 00	15 25	16 75	16 50	15 25
1-lb. cans	18 50	20 00	17 25	18 75	18 50	17 25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$30 00	$33 00	$33 00	$35 00
3x6 and 8	30 00	33 00	33 00	36 00
4x4-6 and 8	30 00	33 00	34 00	37 00
3x10 and 12	30 00	35 00	34 00	38 00
3x14	34 00	35 00	36 00	38 00
4x10 and 12	30 00	33 00	34 00	37 00
4x14	34 00	35 00	36 00	38 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$32 00	$35 00	$37 00
6x14	34 00	37 00	39 00
8x10	32 00	35 00	37 00
8x14	34 00	37 00	39 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York* — 20 Ft. and Under	New York* — 22-24 Ft.	Chicago — 20 Ft. and Under	Chicago — 22-24 Ft.
3x 4 to 8x8	$47 00	$48 00	$46 00	$48 00
3x10 to 10x10	50 00	51 00	49 00	51 00
3x12 to 12x12	54 00	55 00	52 00	54 00
3x14 to 14x14	60 00	61 00	57 00	59 00
3x16 to 16x16	67 00	68 00	61 00	63 00
3x18 to 18x18	80 00	81 00	68 00	70 00
4x20 to 20x20	90 00	91 00	78 00	80 00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under; for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under — P.	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under — P.	Fir
Boston	$58 00	$110 00	.....	$60 00	$75 00	$120 00
Seattle	.....	22 00	.....	.....	.....	23 50
New Orleans	33 00	.....	.....	35.00	35.00	.....
Baltimore	.....	.....	.....	.....	.....	.....
Cincinnati	45.00	*48.00*	*$48.00*	.....	*50.00*	*50.00*
Montreal	50.00	50 00	40 00	38.00	78 00	90 00
Los Angeles	.....	.....	.....	.....	.....	.....
Denver	.....	39 75	38 75	38 75	.....	39 75
Minneapolis	*45.50*	42 75	41 00	.....	*48.00*	43 75
Atlanta	35 00	.....	.....	.....	36 00	.....
Dallas	45 00	.....	.....	.....	48 00	.....
Kansas City	38 75	47 00	47 00	49 50	52 75	.....
Birmingham	32 00	.....	.....	.....	40 00	.....
Philadelphia	45 00	39 00	40.00	44.00	55 00	39 00
Detroit	46 75	48 25	.....	.....	55 75	48 25
St. Louis	44 50	.....	.....	.....	*49 50*	.....

	1-In. Rough, 10 In. x 16 Ft. and Under — P.	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft. — P.	Fir
Boston	$48 00	.....	$48 00	52 00	.....
Seattle	.....	$14 50	.....	.....	$15 50
New Orleans, at mill	70.00	.....	.....	*23.00*	.....
Baltimore	.....	.....	.....	.....	.....
Cincinnati	*47.50*	*77.50*	68 50	40 00	80 25
Montreal	*60.00*	50 00	37 00	45.00	45.00
Los Angeles	.....	.....	.....	.....	.....
Denver	.....	30 25	30 25	.....	33 25
Minneapolis	48 50	40 25	38 50	43 75	38 25
Atlanta	18 50	.....	.....	28.00	.....
Dallas	45 00	36 00	.....	48 60	.....
Kansas City	77 00	38 50	38 50	74 00	40 00
Birmingham	28 00	.....	.....	30 00	.....
Philadelphia	34 50	41 00	40.00	44 50	39 00
Detroit	48 75	40 00	.....	47 00	42 25
St. Louis	*50.00*	.....	.....	*40.00*	.....

Montreal—Up to 32 ft.; over which, $3.00 per M. ft. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, $7@$11 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.315	Detroit	$0.295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2@2.05	$2.50	$1.80

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft., ½-in., 6; ½-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.16½	New Orleans	$0.17½
New York	.17	Los Angeles	.....
Chicago	.18	Seattle	.18
Minneapolis	.18	St. Louis	.17½
San Francisco	.16	Montreal	.30
Atlanta	*.19*	Detroit	.19
Denver	.20	Baltimore	.....
Cincinnati	.17½	Kansas City	.19½
Dallas	.22	Birmingham	.20½
Philadelphia	*.18*		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.30
Boston	.22	.24
Kansas City	.2125	.2325
Seattle	.165	.195
Chicago	.22	.25
Minneapolis	.189	.2094
St. Louis	.22	.25
Denver	.2025	.2325
Dallas	.23	.25
Los Angeles	.....	.....
Atlanta	.23	.26
Baltimore	.....	.....
Cincinnati	.22	.25
Montreal	.195	.235
Birmingham, *delivered*	.20	.22
New Orleans	.235	.265
San Francisco	.1625	.1925
Philadelphia	.25	.28

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$14 50	$11 50	$14 75@15
Stove plate	13 50	12.00	13.50@15.50
No. 1 machinery cast	18 00	16 50	17@21
Machine shop turnings	9 00	4 00	10 00
Cast borings	12 00	5 50	10 50@11
Railroad malleable cast	15 00	12 50	18@19
Re-rolling rails	16 00	13 00	15 50
Relaying rails	28.50	30.00	25@30

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco — Galv.	San Francisco — Black	Seattle Black
½	$6.75	$5.50	$8.00
⅝	6.30	5.05	7.75
¾	6.15	4.90	7.70

Pittsburgh base in lots of 200 kegs or more $3.50.